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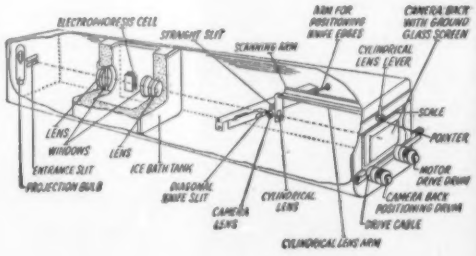

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A Beta-Ray Microscope[1]

William Kerr[2] and H. J. Gomberg[3]

Department of Electrical Engineering, University of Michigan, Ann Arbor

THE POTENTIAL VALUE of radioactive tracers in many fields of physical, chemical, and biological investigation was recognized very soon after the discovery of natural radioactivity. Not, however, until the nuclear reactor made the production of many artificially radioactive isotopes possible on a large scale did the use of radioactive tracers reach anything approaching its present state of development.

The great power of this method of investigation lies in its potential ability to tag a particular atom and thus allow the identification of this atom as an individual.

Thus, for example, the mobility of individual atoms or groups of atoms may be studied in a dynamic system by introducing radioactive atoms into some part of the system and making measurements which determine their rate of appearance at other points in the system (*1*). Studies of the arrangement of atoms in relatively static systems may also be made by incorporating a small portion of a radioactive isotope of the atom of interest into the system and making measurements to determine the structural arrangement of the radioactive atoms.

Since in many chemical and physical situations the radioactive isotopes of an element behave in almost the same way as the stable isotopes, studies made with the radioactive isotopes of an element give information applicable to stable isotopes of this element.

The main determinant in the success and accuracy of any method of analysis which uses radioactive tracers is the precision with which measurements that indicate the presence and concentration of the radioactive isotopes may be made. In some cases only an indication of the concentration of the radioactive isotopes in a rather large region may be sufficient. This is true, for example, in some medical applications such as the study of iodine uptake of the thyroid. In other cases such as the study of the microstructure of metals, it is desirable to be able to locate the sources of radiation to within a few microns.

This paper is concerned with the study of a method for attaining medium precision (of the order of 100 microns) in the location of radioactive isotopes in relatively static systems. The method proposed makes use of a thin transparent scintillator or phosphor as the primary detector of the beta particles emitted by radioactive isotopes. Figure 1 shows the phosphor in contact with the specimen being examined. Some of the energy of the high-energy beta particles from the specimen is converted within the phosphor into visible radiation. The light from an area of the scintillator selected by an optical system is focused on a suitable detector. The location and the amount of the light from the selected area of the thin phosphor layer indicates the presence and concentration of radioactive atoms in that part of the specimen directly below.

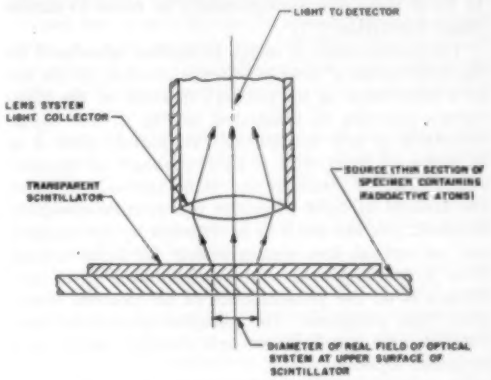
LIGHT TO DETECTOR
LENS SYSTEM LIGHT COLLECTOR
TRANSPARENT SCINTILLATOR
SOURCE (THIN SECTION OF SPECIMEN CONTAINING RADIOACTIVE ATOMS)
DIAMETER OF REAL FIELD OF OPTICAL SYSTEM AT UPPER SURFACE OF SCINTILLATOR

FIG. 1. Source scintillator arrangement.

An analysis of this method has been made, and an attempt has been made to compare the analysis with experiment. With the method that has resulted from this study it is possible to locate certain radioactive sources to within at least a 100-micron diameter field on or near the surface of a thin flat section of a specimen containing radioactive atoms. Such a determination is made in a matter of a few minutes, since the method involves determination of the instantaneous rate of decay of isotopes in the field.

Expected Resolution and Sensitivity of Proposed System

Because of the high specific ionization caused by alpha particles in their passage through matter, the best resolution in the location of radioactive isotopes can be attained for those isotopes that emit alpha particles. Since the alpha-emitting isotopes are restricted to a relatively few elements, it is desirable that a system which is to be generally useful as an investigative tool be capable of detecting other particles.

The nuclear reactor has made many beta emitting isotopes readily available to investigators. For a known energy the maximum range of a beta particle can be fairly accurately predicted (*2*). Since beta emitting isotopes lend themselves reasonably well to

[1] This investigation was supported by the Atomic Energy Commission under Contract AT-11-1-70 No. 3.

[2] Assistant Professor, Electrical Engineering, University of Michigan.

[3] Associate Professor, Electrical Engineering and Assistant Director, Michigan Memorial Phoenix Project, University of Michigan.

precise location problems, it was decided to design a system having maximum efficiency in the detection of betas.

Suppose one wishes to determine the pattern of the distribution of the radioactive atoms in the surface structure of a specimen. Since the emitted betas are high-speed charged particles, some method of focusing these particles upon a suitable detecting device in order to produce an image might seem to be a possibility. However, except for those few isotopes in which conversion electrons are produced, the electrons which are emitted may have any energy from zero up to a maximum value typical of the particular isotope considered. Since the emitted betas have a wide continuous spectrum of energies, it is almost impossible to focus them electromagnetically in order to obtain image formation (*3*).

The complication in image formation introduced by the wide range of beta energies is avoided by the use of a scintillator as the primary detector of the high-energy particles as illustrated in Fig. 1. The image formation is now considerably simplified, since it is in terms of light with a narrow range of energies rather than in terms of the betas themselves. Since the amount of light produced per particle-phosphor interaction is too small to be detected by the unaided eye, an optical lens system selects the light coming from a specified area of the scintillating layer and focuses it on the photocathode of an electron multiplier type phototube. The phosphor-phototube combination with suitable electronic circuitry serves as a radiation detector.

In order to achieve maximum resolution with the proposed method of locating radioactivity it is important that both source and detecting layer be thin (*4*). The phenomenon which is actually measured is the path or paths of the betas. Resolution thus depends upon how sensitive the method of measurement is to a variation in the density of paths within the scintillator as a function of distance from a source. Since the greatest variation in radiation intensity with distance from a point source occurs nearest the source, it is important for high resolution that all possible sources be as near the scintillator as is practicable. This implies both sources and scintillators as thin as can be prepared without changing their normal physical characteristics.

The phosphor indicates the passage of a beta particle by absorbing the particle energy and converting some of it into electromagnetic radiation in the visible or near visible region. In order that enough light may reach the phototube through the collector it is important that the conversion efficiency of the phosphor be high. In a system which achieves a resolution of 100 microns the phosphor cannot be much thicker than this. The more efficient organic phosphors will not absorb all the energy of even a maximum energy carbon-14 beta in this thickness. (The carbon-14 beta with maximum energy of 155 kev has a range in anthracene of about 240 microns.) It is clear that a compromise has to be reached between sensitivity and resolution for all but the very low energy betas.

The sensitivity and resolution might both be improved if a very dense phosphor were available. Cadmium tungstate was tested for this reason, but was found to give results much inferior to those given by anthracene. Of all the organic phosphors tested anthracene proved to be the most sensitive in thin sections.

To establish the resolution it is necessary to know how close to the particle path the light is produced. The passage of a high-energy particle through anthracene and the energy conversion process producing the scintillation radiation is apparently a property of the molecular structure. Anthracene in common with most other organic phosphors is characterized by conjugated double-bonded carbon atoms in benzene rings. The passage of the particle probably disrupts the arrangement of the electrons in the closed ring molecules, perhaps by producing changes in the electron spins and the energy distributions associated with the alternating single and double bonds (*5*). The light is thus probably emitted by the disturbed molecule, very near the path (certainly within 1 micron) of the beta particle. The light source resulting will be a line source with intensity that is in many cases almost uniform along the path length.

A microscope objective lens placed with its axis perpendicular to the phosphor surface selects a circular field on the phosphor surface. The size of the selected field can be controlled by placing a circular aperture at the image plane of the objective. The amount of light collected from a light source within the selected field depends both upon the numerical aperture of the objective lens and the index of refraction of the phosphor. An analysis, based upon geometric optics, and assuming a flat polished phosphor surface, shows that the maximum fraction of the light produced at a source point within the phosphor is transmitted through the optical system if the source point is on the objective axis. Only a negligible fraction of the light produced outside a cylindrical section determined by the real field of the optical system at the upper surface of the phosphor (see Fig. 1) is transmitted by the optical system. Hence the resolution can be determined by the size of the field-determining diaphragm placed at the objective image plane.

The conversion efficiency for anthracene was computed from data given by Hofstadter, Kallman, and Gillette to be about 7.5 per cent for betas (*6–8*). This figure is what Kallman calls the "physical efficiency" of the phosphor, that is, the actual efficiency with which the beta energy is converted into scintillation radiation. A 97 × American Optical microscope objective with a numerical aperture of 0.828 was used as a light collector. Calculations were made assuming all the visible radiation to be emitted at a point on the objective axis. Mean photon energy was taken as that of a photon at the radiation peak of anthracene at 4440 A (*9*). Under the optimum condition of a maximum energy beta with all its energy absorbed in anthracene, results indicating the number of photons

TABLE 1. Mean photon yield per event.

Isotope	Cobalt-60	Carbon-14	Nickel-63
Photons to single photocathode	393	197	77
Photons to each of two photocathodes	180	90	35
Electrons from photocathode	17.85	8.93	3.47

delivered to a phototube cathode may be obtained.

Table 1 gives the results for an anthracene scintillator and three different isotopes: Cobalt-60 with a maximum beta energy of 310 kev, carbon-14 with a maximum of 155 kev, and nickel-63 with a maximum of 60.7 kev. For reasons to be discussed later a light splitter was used to divide the light from the objective into two approximately equal parts. The transmission of this light splitter was about 92 per cent. The second entry of Table 1 gives the resultant number of photons to each of two phototubes when the light splitter is used.

Calculations using the manufacturer's data indicate that the quantum efficiency for the photocathode of the type 1P21 phototube at 4440 A is about 9.92 per cent. The third entry of Table 1 gives the average number of electrons from the photocathode for an interaction involving a peak energy beta. On the average, of course, an event might result in a considerably smaller number of photons than that indicated in this table since the mean beta energy is roughly one-third the maximum.

Since the assumptions of a point source and maximum beta energy made in getting the results listed in Table 1 are not usually met in practice, these results serve only as an indication of an optimum pulse size to be expected in practice. Thus the results of the third entry would seem to indicate that enough light should reach each of two phototubes from interactions of some of the betas from cobalt-60 and carbon-14 to give a detectable signal. Nickel-63 would seem from these results to be near the borderline of detection. Experiment shows that it is indeed possible to detect both cobalt-60 and carbon-14 within a 75-micron diameter field on the surface of a section of anthracene 50 microns thick. Nickel betas can also be detected, but the detection efficiency for nickel is low.

The Noise Problem

As is well known to anyone who has had occasion to use electron multiplier type phototubes many pulses appear at the anode that are not caused by the release of photoelectrons at the cathode. If a signal is represented by the release of photoelectrons from the cathode, some method must be found for distinguishing between these signal pulses and the spurious pulses which are frequently referred to as noise.

Since many of these noise pulses result from thermal emission of electrons from the photocathode and from the dynodes (Morton has reported 9500 electrons per second thermally emitted from the photocathode at room temperature as being typical of a 1P21 phototube [*10*]), cooling of the tube is a satisfactory laboratory method of reducing noise. Cooling, however, introduces some rather formidable problems in insulation because of the condensation of moisture on the cooled parts. Since it was felt desirable to eliminate these problems in this equipment, a different approach, that of using two phototubes in coincidence, was tried.

The use of two phototubes in coincidence to reduce the effect of the random noise pulses of an individual tube is a well-developed technique in the field of scintillation counting (*11–13*). In most cases the two tubes are arranged so that each tube views the phosphor directly. A part of the light generated in the phosphor falls on each tube individually. The unique feature of the method of detection used in the microscope described here is that the optical system gathers the light from a small selected area of the phosphor, and transmits it to a light splitter. The light splitter divides the light approximately in half, and each half goes to a phototube.

Figure 2 is a simplified diagram of the optical system and the light splitter. Note that for a point slightly off the objective axis the light split will not be exactly 50–50. The closer the source is to the objective axis the more nearly will the light going to the two phototubes be equal.

The light splitter used in the optical system is a right angle prism with the vertex of the right angle ground to a sharp edge. Aluminum was evaporated in a vacuum on the sides adjacent to the right angle in order to form a reflecting surface. The coefficient of reflection of aluminum evaporated on glass is about 0.92 at the radiation peak of anthracene (*14*). Thus approximately 0.46 of the light from the objective is delivered to the phototube.

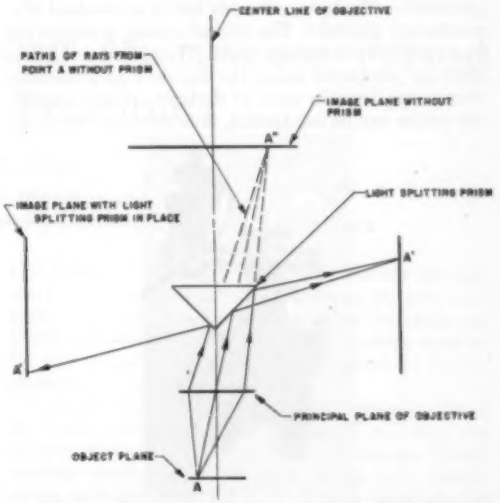

FIG. 2. Simplified diagram of path of light through optical system.

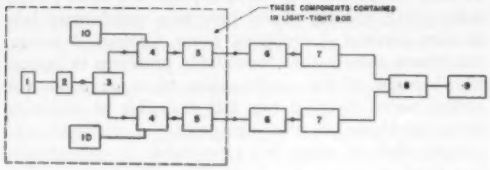

FIG. 3. Block diagram of apparatus. 1, source; 2, phosphor; 3, optical system; 4, phototubes; 5, pulse preamplifier; 6, pulse amplifier and shaper; 7, pulse amplitude selector; 8, discriminator; 9, recorder; 10, high-voltage supply for phototube.

The use of a fairly conventional coincidence circuit having a resolving time of 0.25 microsecond with the system as presently designed decreases the background from several thousand counts a minute typical of one tube, to a few counts a minute for the two tubes in coincidence.

DESCRIPTION OF APPARATUS

A block diagram of the beta-ray microscope is shown in Fig. 3. The components will be described below.

1. The source is in the form of a thin flat section of a material containing the isotopes to be detected.

2. The phosphor is a thin section of an anthracene crystal placed in contact with the surface of the specimen being studied. Small crystals of from about 15 to 100 microns in thickness have been grown by evaporation from a large crystal and recondensation. Small sections about 200 microns thick and thicker can be shaved from a larger crystal with a sharp razor blade.

3. The optical system gathers the light from a selected area of the phosphor, splits it approximately in half, and focuses it on the photocathodes of the phototubes. The light gathering lens is a standard 97 × microscope objective. The optical system is supported by a modified microscope stand. The source and phosphor are positioned under the objective by a movable microscope stage. In place of the light splitter a standard ocular can be substituted, thus allowing the specimen surface to be visually examined through the thin transparent phosphor.

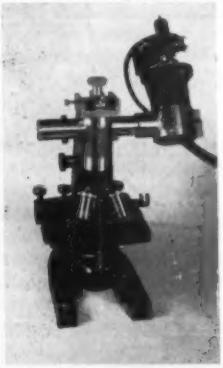

FIG. 4. Optical system and phototube holder. Note preamplifier attached to phototube holder.

4. The phototubes convert the light pulses striking their photocathodes into electrical pulses. Since the light being detected is of a very low intensity, they must be operated in complete darkness. In the present model of the microscope the source, the phosphor, the optical system, and the phototubes are all housed in a light-tight enclosure. This enclosure may be removed for adjustments and for visual viewing of the specimen surface.

5. The preamplifiers are used here as impedance matching devices, which allow the impedance across the phototube anode to be relatively independent of the linear amplifier input impedance.

6. The linear amplifiers amplify the pulses from the preamplifiers, approximately preserving the maximum amplitudes, but not necessarily the pulse shapes. This amplification is necessary in order that the pulses be large enough to operate properly the coincidence circuit.

7. The pulse amplitude selectors give no output for input pulses smaller than some selected amplitude. Each input pulse larger than this selected amplitude produces an output pulse of a uniform width and amplitude. This uniformity gives much more reliable operation of the coincidence circuit than do nonuniform pulses. The amplitude selectors can be set to eliminate many small noise pulses without appreciably affecting the signal pulses.

8. The coincidence circuit is used to reduce the noise background of the phototube detector as discussed earlier.

9. The recorder may count pulses over a selected time interval or it may be in the form of a count rate meter. Usually for weak sources the individual pulse count is preferable.

10. The phototube power supplies are stabilized high-voltage supplies adjustable over a range of from 600 to 1050 volts. Individual supplies allow for differences in the two phototubes.

In Fig. 4 is shown the optical system in place on the frame of a standard medical microscope. A phototube holder is normally mounted on each of the horizontal brass tubes extending outward from the light splitting prism. Only one phototube is shown in the figure. The preamplifier can be seen on top of the phototube holder.

RESULTS

Satisfactory detection of betas from cobalt-60, thallium-204, carbon-14, and nickel-63 has been achieved with anthracene crystals 50 microns thick. The selected phosphor field was 75 microns in diameter. Activities were of the order of 1 microcurie per square centimeter. Light collection was accomplished with a standard 97 × microscope objective focused on the phosphor surface. The field was defined by means of a circular aperture placed in the image plane of the objective.

For carbon-14, betas detection efficiencies as high as about 50 per cent have been achieved with a 200-

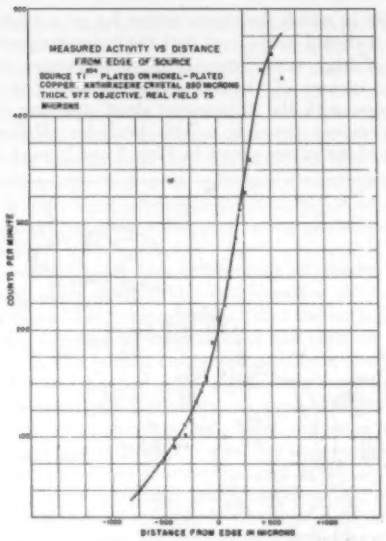
MEASURED ACTIVITY VS DISTANCE FROM EDGE OF SOURCE
SOURCE Tl²⁰⁴ PLATED ON NICKEL-PLATED COPPER. ANTHRACENE CRYSTAL, 250 MICRONS THICK. 97X OBJECTIVE. REAL FIELD 75 MICRONS
COUNTS PER MINUTE
DISTANCE FROM EDGE IN MICRONS

FIG. 5. Measured activity *vs.* distance from edge of source. Source, Tl^{204}, plated on nickel-plated copper. Anthracene crystal 250 microns thick. 97 × objective. Real field 75 microns.

micron-thick anthracene crystal. The best detection efficiency achieved with nickel-63 to date has been about 2 or 3 per cent.

Figure 5 is a plot of measured count rate against distance from the edge of a source. The source was thallium-204 plated on nickel-plated copper. Source intensity was about 1.5 microcuries per square centimeter. The source was flat, about 1 cm. square. The zero point on the abscissa was the approximate edge of the metal as observed visually with the microscope objective and an ocular.

An improved model of the microscope is now under construction, which will allow visual viewing of the selected field to be more easily accomplished. The adjustment of selected field diameter will also be easier on this model.

Additional investigation of plastic phosphors is also planned, because of the ease with which thin sheets can be fabricated. Those presently available have only about 40 per cent the conversion efficiency of anthracene, but it is possible that this can be improved.

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The Relationship Between Microseism Period and Storm Position[1,2]

William L. Donn

Brooklyn College, Brooklyn, and
Lamont Geological Observatory of Columbia University, Palisades, New York

IN THE COURSE OF SEVERAL YEARS of microseism study, a wealth of data on the relationship of microseism period to the position of the generating storm has been accumulated. Since the work was performed by many different record readers, including the writer, over many years, and before this presentation was anticipated, the results are considered to be quite objective. Hurricanes were used for the correlations in this study since they presented a fairly limited generating area and are the only storms of significant intensity occurring in lower latitudes. The seismograph stations used in this study are listed in Table 1 together with their symbols used on the charts and the type and peak response of the instruments available.

Average period data from the 16 hurricanes listed in Table 2 were utilized in this study and only the values corresponding to the times of the six hourly weather charts were used. These values were plotted along each hurricane track at six-hour intervals for each station that recorded microseisms that could be attributed to the hurricane. A total of 353 observations

[1] This research was supported by Contract N6onr 27133 and Contract AF 19(122)441 between Columbia University and the Office of Naval Research, U.S. Navy, and the Geophysics Research Division of the U.S. Air Force, respectively.
[2] Lamont Geological Observatory Contribution No. 93.

TABLE 1.

Station and symbol	Instrument	Peak response
Antigua—A	Sprengnether	7 sec
Bermuda—B	Sprengnether (U.S. Navy)	7
	Milne-Shaw (USC&GS)	10
Cherry Point—CP	Sprengnether	7
Fordham—F	Galitzin	12
Guantanamo—G	Sprengnether	7
Halifax—H	Milne-Shaw	10
Miami—M	Sprengnether	7
Palisades—P	Columbia (Galitzin-type)	12
Richmond—R	Sprengnether	7
Roosevelt Roads—RR	Sprengnether	7
San Juan—J	Wenner	10
Swan Island—S	Sprengnether	7
Trinidad—T	Sprengnether	7
Weston—W	Long-period Benioff	1*
Whiting—WH	Sprengnether	7

* Has 60-sec galvanometer.

of such six hourly period averages were entered. Then each five-degree square crossed by one or more tracks was quartered. The number of observations in any quarter depended on the number of tracks crossing it and the number of stations within range. Hence the frequency of period observations in any quarter varied from 1 to 19; the average frequency was 6. Depth contours in Figs. 1 and 2 are in fathoms.

The circled numbers in Fig. 1 show the average microseism period for each quarter of a five-degree square for which any observations were available. In Fig. 2, the maximum period in each quarter is shown. It is evident from Fig. 1 that a distinct short-period zone of 2.5 to 3.5 sec occurs in the Gulf of Mexico. The continental shelf generally exhibits 3 to 4 sec microseisms. The elongated zone between Bermuda and the 1000 fm contour off the east coast seems to be characterized by 4.5 to 5.0 sec. The ocean area generally southeast of Bermuda is characterized by 5.5 to 6.0 sec. Figure 2 showing maximum periods, indicates two other zones of long-period in the region south-southwest of Newfoundland, just beyond the 1000 fm contour, and a more restricted area just north of the eastern West Indies arc. This figure also emphasizes more strongly the region of long-periods southeast of Bermuda. In Fig. 3, the number of observations in each quarter are shown to the left of the slant within each circle. The average deviation of period is shown to the right of the slant.

Although the period observations are plotted in the quarter in which the storm center lay at a particular time, it should be realized that the generating area, or area of high wind intensity of a hurricane, usually covers an area of about five degrees square in lower latitudes, with the dimensions about doubling as the storm moves through middle latitudes. Hence for many of the values shown in Figs. 1 and 2, part of the generating areas associated may have been over land, or part may have been over deep water and part over shallow. Some ambiguity is thus introduced for these cases if a real depth period relationship exists. Since it has already been shown (*1*) that coastal stations record a rather broad spectrum from coastal storms and a narrow spectrum from ocean storms, it must be realized that values near the continental margins may be averages of fairly broad period spectra, with the emphasis on the longer periods owing to the instruments used.

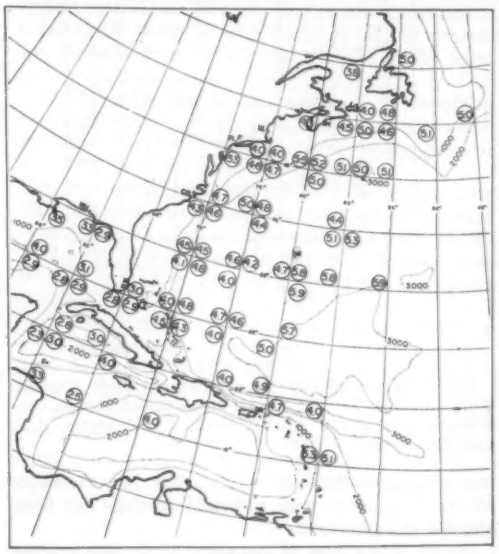


FIG. 1.

Figure 2, showing maximum periods, was plotted since a comparison of many records from several stations for distant storms has shown that the maximum period recorded may be more reliable for a position-period relationship. The signal to noise ratio for many of the stations, especially Bermuda, is sufficiently low at long periods that such microseisms, when of distant origin, require generation by very intense storms in order to show above high short-period microseisms of closer or more local origin. This has been verified by comparison of many instruments of different sensitivities at Palisades and Bermuda for the same ocean storms.

Although the general trends are the same in Figs. 1 and 2, more definite period "highs" are seen to exist in the regions south of Newfoundland and southeast of Bermuda in Fig. 2.

TABLE 2.

1. Aug. 19, 1944	9. Aug. 31–Sept. 11, 1949
2. Aug. 26–Sept. 3, 1948	10. Oct. 14–20, 1949
3. Sept. 10–15, 1948	11. Aug. 14–23, 1950
4. Sept. 19–26, 1948	12. Aug. 20–31, 1950
5. Oct. 5–8, 1948	13. Aug. 31–Sept. 14, 1950
6. Aug. 21–27, 1949	14. Sept. 1–7, 1950
7. Aug. 24–28, 1949	15. Aug. 11–16, 1953
8. Aug. 26–Sept. 5, 1949	16. Sept. 4–8, 1953

Bathymetric charts show that a small major deep area of 2900 fm to 3000 fm coincides with the period high south of Newfoundland, and that a major basin area of over 3000 fm lies to the southeast of Bermuda, coinciding with the period high there. A narrow trench of great depth (over 3000 fm) also coincides with the area of the less definite high just north of the West Indies. Here the trench is sufficiently restricted so that only part of a hurricane could overly it at any time, introducing some ambiguity in any period-depth relationship.

The short-period values in the Gulf of Mexico are not significantly changed by consideration of maximum periods. It may be significant that the only areas of 4.0 sec microseisms recorded for the Gulf in this study are in the central deeper region (near the 90th meridian), and in the deep region south of Cuba. Since the Gulf and Caribbean stations used similar Sprengnether instruments with peak response at 7 sec, it appears that the low values for this region are not a function of the instrumentation.

Further, since hurricane winds and resulting swell in the Gulf reach measured velocities and wavelengths respectively, not significantly different from those in the Caribbean and Atlantic, it is difficult to explain the observed period discrepancies on the basis of wave or swell generation, either in the storm area, or at the coast. The only obvious correlation seems to be one of depth of water, or possibly depth of water and sediments. The latter would explain period variations where water depths appear to be the same. Owing to the broad area of generation the exact relationship is difficult to ascertain at present.

The use of instruments with increased sensitivity at long-periods, and in particular the use of resonant seismographs, have indicated even longer periods for the deep area south of Newfoundland than the values given here. Similar instruments will be placed on Bermuda and the results of these studies published separately. It now seems well established that restricted storms or cold fronts over relatively shallow continental shelf waters generate periods from 2 to 4 sec.

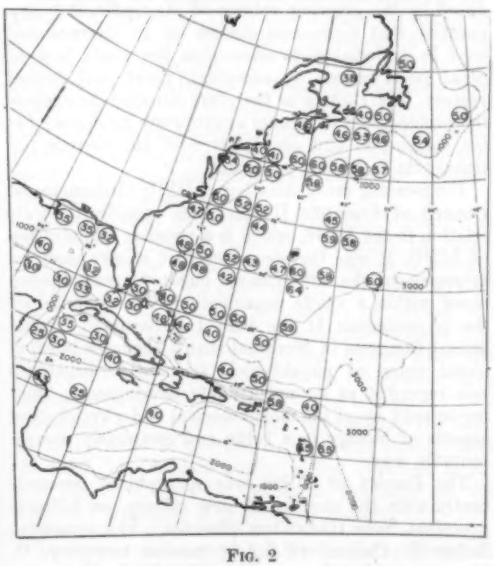


FIG. 2

FIG. 3.

The effect of microseism path on recorded period seems to be unimportant in view of the generally small average deviations shown in Fig. 3. Since the precision of period measurements was 0.2 sec for most of the stations and as much as 0.4 to 0.8 for the rest, it is evident that most of the deviations lie within this reading error. Further, studies of numerous individual case histories (*1*) has shown apparently insignificant period differences at different stations from the same ocean storms.

In summary, a study of the distribution of microseism periods in the Gulf of Mexico, the Caribbean Sea, and the western North Atlantic Ocean recorded variously at 15 stations from 16 hurricanes shows that a definite relationship exists between microseism period and storm position. The only obvious correlation appears to be with water or water and sediment depth. The short periods characteristic of the Gulf of Mexico and the continental shelf tend to negate ocean waves or swell as the generating mechanism. R. Vestrich, M. Black, R. Katz, and J. Hirshman aided in reading the records and plotting data.

Reference

1. DONN, W. L. *J. Meteorol.* 9, No. 1, 61 (1952).

News and Notes

XIth General Assembly of the International Union of Biological Sciences Nice, France, August 17-21, 1953

THIS meeting marked, it is believed, a turning point in the history of the IUBS. The rapid growth of the biological sciences in recent years and the need for more cooperation and coordination on the international level has made the need for such an organization more imperative, while at the same time the existing administrative set-up, low budget, and lack of support have made the IUBS quite ineffective. The meeting of the 11th General Assembly was attended by delegates from Australia, Austria, Belgium, Denmark, France, Great Britain, Israel, Italy, Japan, Netherlands, Sweden, Switzerland, the United States, and Yugoslavia, and representing as individuals the several sections of biometry, botany, cell biology, embryology, entomology, genetics, limnology, microbiology, and zoology. The principal discussion revolved about the need for reorganizing the IUBS and for developing a strong and forward-looking program, one that would be less preoccupied with its own administrative affairs and more broadly dedicated to the international problems of biological science. This goal cannot be achieved without a considerable increase in the sums of money available to the organization, which in 1952 received as total dues from the member nations only $1955. Figures compiled by R. E. Cleland, U.S. delegate, show that very few other international scientific unions have so small a budget. The union for geodesy and geophysics has $26,700; that of astronomy $23,500; and that of chemistry $13,800. If the biological sciences are to accomplish much, they will require some similar amount.

In the past the program of the IUBS has included (a) support of three colloquia per year, (b) small appropriations for four abstracting services (*L'Année Biologique, Biological Abstracts, Resumptio Genetica,* and *Zoological Record*) and for three international committees on nomenclature (zoology, botany, bacteriology), and (c) some support for four international biological centers: (1) a live collection of *Drosophila* species, at the University of Pavia; (2) a depository of microscopic slides and preparations, at Louvain (see p. 3A, advertising section, of this issue); (3) a serological museum, at Rutgers University; and (4) an institute of human heredity, at Copenhagen. For 1954, symposia are planned on the culture of vegetative tissues, in connection with the 8th International Botanical Congress to be held in Paris; a second, on the evolution of the benthic life of great lakes (Pallanza); and a third on some aspect of cytology, in connection with the International Congress of Cell Biology to be held at Leiden. For 1955 it is contemplated that the subjects will be in the fields of embryology, biometry, and entomology, and in the U.S.A., Brazil, and Brazil, respectively. For 1956, the tentative subjects selected are the comparative biology of aquatic animals from the biogeographic point of view (Italy); the biosynthesis of antibiotics (Belgium); and some aspects of applied genetics (Japan).

A plea for more attention on the international level to the critical need for methodically organizing the task of comprehensively and effectively abstracting and indexing the world biological literature was met with a unanimous agreement that steps should be taken to that end. The undersigned was made chairman of a new international committee with power to investigate present practices and needs and to make recommendations for improved procedures.

The two following resolutions dealing with the international exchange of biological materials and with crop protection, respectively, were adopted after having been proposed by the U.S. delegation:

"In view of the urgent need for facilitating international information and exchange of biological materials (animals, plants, cultures, preparations, etc.) for purposes of research, testing, assaying and teaching, the Bureau is directed to recommend measures by which the various national services already concerned with the problems of biological supplies could be brought into closer cooperation and their transnational activities facilitated (e.g., shipping and quarantine regulations, certification, international registry, etc.) and such services be inaugurated in countries where they are not yet in existence."

"In view of the rapidly increasing danger to crop plants from foreign pathogens inadvertently introduced by the growing volume of air traffic, it is imperative that large-scale studies on an international level be undertaken to encompass the whole field of plant pests caused by microbial, plant, and animal vectors. The Bureau is therefore directed to explore the problem and to initiate appropriate machinery for the correlation and coordination of the various national attacks on this problem."

The pending reorganization of ICSU (International Council of Scientific Unions) was considered in its relation to the IUBS, which is a member organization of ICSU. It was the consensus that in any such rearrangement the life sciences ought to remain combined within a single organization. The proposal of the physiologists at the 19th International Physiological Congress in Montreal that a separate international union of physiological sciences be organized was regarded as an unfortunate development, tending to split apart the morphological and physiological aspects of biology in a futile and completely unwarrantable way.

The Bureau of IUBS was reorganized concomitantly with the election of new officers, as follows: president, Sven Hörstadius (Sweden); vice president, Ralph E. Cleland (U.S.A.); general secretary, G. Montalenti (Italy); secretary, R. Ulrich (France); and treasurer, A. Linder (Switzerland). The main

offices of the Bureau, in accordance with the residence of the new secretary general, will move to Naples. As a major step in the reorganization and reinvigoration of IUBS, a policy board is to be set up, to act as advisory council to the Bureau in all matters of basic policy and planning. The policy board is to be composed of eminent scientists selected irrespective of country or biological specialty. Its first task will be to draft a new constitution more in keeping with the problems and needs of international biology at the present time.

It is truly gratifying to be able to report that the meeting ended, in the words of Paul Weiss, chief U.S. delegate, in a crucially needed reorganization and in a new spirit. "Policies were broadened; new programs outlined; the administrative machinery simplified; new personnel elected in the interest of rotation; a 'bicameral' system instituted by the creation of a scientific policy board to supplement the administrative bureau; a campaign to increase membership and to raise dues and contributions inaugurated; and a number of new projects of practical significance undertaken. Above all, an improved community spirit was affirmed among the various nations and disciplines, which if given the needed encouragement and practical means of support promises to make the IUBS into a truly vigorous and effective international instrument."

BENTLEY GLASS

U.S. Delegate

Science News

The National Committee of Genetics and the National Committee of Plant and Animal Breeding of the Science Council of Japan has issued ***A List of Geneticists in Japan, 1952.*** The booklet contains the names and addresses of 381 geneticists now conducting research in genetics "proper and applied." Also listed for each person is the year of birth, degree, present position, and chief interest. An Appendix contains the representative institutions of genetics and breeding in Japan.

What is most noteworthy about this directory is the rapidly increasing number of scientists in Japan who are working in this field. The number is already nearly half that of the geneticists in the United States, which leads the world in the number of persons engaged in this branch of experimental biology. The comparative recovery of Japanese science since the end of the war thus appears to be far greater than that of Western Germany. If Japan is now virtually the second nation in scientific productivity (a matter that should be checked by a careful study), then the need for adequate guides to the Japanese scientific literature, most of which is published in the Japanese language, is of growing concern.

To facilitate the work of mechanical pickers, almost half of the 1,600,000 acres of cotton grown in California last year were treated with chemicals that remove the leaves. Frederick T. Addicott, associate professor of botany at the University of California at Los Angeles, has reported that, although several good types of **chemical defoliants** are now in use, there is room for improvement. More than 1000 new chemicals are being tested for their defoliating properties. Dr. Addicott is seeking to identify the anti-enzymes which are involved in defoliation. The research is being supported by the California Planting Cotton Seed Distributors.

Derivatives of uridine-5′-phosphate (uridylic acid). For some years adenosine triphosphate and other derivatives of adenylic acid, such as the various nicotinamide and flavine dinucleotides, have played central roles in the development of intermediary metabolism.

Recently, increasing interest has developed in the metabolic activities of derivatives of uridylic acid, the uracil analogue of adenylic acid. It is recognized, for instance, that orotic acid enters into nucleic acid synthesis by way of conversion to uridylic acid. It was shown by Park in 1952 that in penicillin inhibited bacterial cultures there was an accumulation of nucleotides in which uridine diphosphate was coupled to an acetyl hexosamine. Quantitative studies by Strominger with labeled uracil indicated that inhibition of nucleic acid synthesis by penicillin is quantitatively related to the accumulation of uracil and cytosine nucleotides. Also in 1952 Paladini and Leloir showed that a new coenzyme, uridine diphosphate glucose, was involved in the conversion of galactose-1-PO_4 into glucose-1-PO_4 by yeast.

More recently Dutton and Storey have shown that uridine diphosphate glucuronic acid is active in the synthesis of menthol glucuronide by a liver enzyme. Leloir and Cabib have found that uridine diphosphate glucose in the presence of a yeast enzyme will react with glucose-6-PO_4 to form uridine diphosphate and trehalose phosphate. It seems evident that some derivatives of uridylic acid are active in certain transglycosidation reactions. Kornberg succeeded in showing that phosphopyruvate would react with uridine diphosphate in an enzyme catalyzed reaction to yield pyruvate and uridine triphosphate, an analogue of adenosine triphosphate. More recently the isolation of uridine triphosphate from yeast by ion-exchange chromatography was announced by Lipton, Morell, Frieden, and Bock. Although it is evident that uridine triphosphate is present in yeast, its functions are as yet unknown.

In view of these evidences of the metabolic activity of uridine-5′-phosphate derivatives, the recent announcement by the Pabst Laboratories of Milwaukee that purified uridine triphosphate is now commercially available will be received with great interest by biochemists. For references see *J. Am. Chem. Soc.* **75**, 5449 (1953).—M.H.A.

The University of California has the first fossil **Diprotodon,** an ancient marsupial resembling a rhinoc-

eros, ever to be sent out of Australia. Last summer R. A. Stirton, chairman of the Berkeley Department of Paleontology, led an expedition which found a burial ground of the ancient beasts near Lake Callabonna, in South Australia about 1000 miles from Adelaide. The burial ground may contain up to 1000 fossil specimens of the diprotodon. The specimens taken out by Dr. Stirton's party were the first complete ones ever recovered.

The establishment of a National Science Foundation Advisory Committee to consider the effects of government support to colleges and universities on their research and teaching functions has been announced. The Committee was authorized by the National Science Board, which also selected its own chairman, Chester I. Barnard, to be the chairman of the Committee. The other members are:

Arthur S. Adams, American Council on Education
Vannevar Bush, Carnegie Institution of Washington
James S. Coles, Bowdoin College
Harold W. Dodds, Princeton University
Conrad A. Elvehjem, Graduate School, University of Wisconsin
T. Keith Glennan, Case Institute of Technology
Virgil M. Hancher, State University of Iowa
William V. Houston, Rice Institute
Clark Kerr, University of California, Berkeley
C. N. H. Long, Yale University
Don Price, The Ford Foundation
Julius A. Stratton, Massachusetts Institute of Technology

Those concerned with higher education have long recognized that the extent and scope of financing by government of development projects and research in universities and colleges raises some important questions about the effects of such funds upon the customary teaching and research activities of the institutions. During World War II and the postwar emergency period many millions of dollars have been spent by government agencies for procurement of services in technological developments in universities and colleges. Relatively few millions of dollars have been provided for research and education in the sciences, although in many instances these institutions are uniquely fitted to carry on such activities.

A closely related question to which the Committee may also give attention is how the federal government, in cooperation with the colleges and universities, may best develop and encourage research and education in the sciences. These matters will receive objective study and appraisal by the Foundation with the advice of the Committee. The results of the study may be expected to have substantial value both to government agencies and the institutions of higher education.

Statistics compiled by the Foundation indicate that during the year ending June 30, 1952, educational institutions received almost $300 million from federal agencies for development and research. Approximately $136 million (46 percent) was spent by instructional departments. Of the rest, about $3 million was spent by affiliated research organizations, $12.5 million by agricultural experiment stations, and $143.5 million by research centers, which were administered by educational institutions for specific federal agencies but organizationally segregated from the normal activities of the institutions. According to the Foundation a total of 225 educational institutions received some federal support for development and research in 1951–52; these included 86 universities, 95 liberal arts colleges, 41 professional-technical schools, and three other educational institutions.

Gypsy moth caterpillars ate the leaves off 1,500,000 acres of trees in New England last year. This resulted in more than double the defoliation caused by the record outbreaks of 1945 and 1937 when approximately 600,000 acres of trees were damaged. E. D. Burgess of the Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, has reported that gypsy moth outbreaks seem to run in 8-year cycles. Scientists are unable to explain why the recent attack was so acute.

Defoliation must normally continue for several seasons before trees are killed, although partial defoliation will retard growth. Hardwood trees suffer the most, because routine spraying now protects fruit orchards. DDT is an effective aid, and this year 186,000 acres were treated.

The gypsy moth (*Porthetria dispar*) was imported into the country in 1886 and the federal government's control efforts are primarily directed toward confining it to the New England area. Parts of all the New England states and the eastern edge of New York are troubled by the pest. Last season Massachusetts received the heaviest damage. Preliminary surveys indicate that there may be another serious outbreak this year.

The National Bureau of Standards *Technical News Bulletin* for Nov., 1953, devotes nine pages to **Project Tinkertoy**, an automatic production line for the manufacture of electronic products, and a novel system making this possible, that was developed by NBS under a program sponsored by the Navy Bureau of Aeronautics.

Starting from raw or semiprocessed materials, machines automatically manufacture ceramic materials and adhesive carbon resistors, print conducting circuits, mount resistors, capacitors, and other miniature component parts on standard, uniform steatite wafers. The wafers are stacked very much like building blocks to form a module that performs all of the functions of one or more electronic stages. Automatic inspection machines check physical and electrical characteristics of the parts-mounted wafers at numerous stations along the production line. The completed module is a standardized, interchangeable subassembly combining all of the requirements of an electronic circuit with ruggedness, reliability, and extreme compactness.

The key to this automatic, mechanized production of electronic equipment in Project Tinkertoy is the design system. Called MDE, for Modular Design of

Electronics, the system establishes a series of mechanically standardized and uniform modules, or building blocks, producible with a wide range of electrical characteristics. Each module, in general, consists of some four to six thin ceramic wafers, bearing various circuits associated with an electronic stage. A number of individual modules are combined to form a major subassembly. The composition of modules into major subassemblies is possible because there is great similarity between circuits and parts of circuits in modern electronic equipment.

The production system that has been developed is called MPE, Mechanized Production of Electronics. MPE largely utilizes noncritical raw materials. Ceramic wafers, ⅞ in. square by 1/16 in. thick, are produced directly and in quantity from the raw ingredients. Ceramic capacitors are made in a similar fashion, and another part of the line produces adhesive tape resistors.

These and other basic parts are fed into the production line. The appropriate circuits are printed by automatic machines, and the circuit configuration is achieved through photographic processing. Quality control is established by automatic inspection, directed by information prepared in punched card form. Special components, not suitable for "printing" techniques, can be incorporated into the modules. Automatic physical and electrical inspection is provided for in the production line.—K. L.-H.

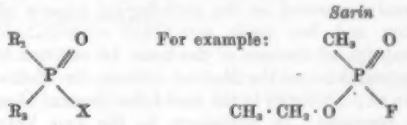
An overall picture of **tropical weather in the Pacific** is beginning to emerge. Louis B. Slichter of the Institute of Geophysics, University of California at Los Angeles, attributes this development to three things: (1) World War II, (2) atom bomb tests, and (3) the efforts of the U.C.L.A. meteorological research team sponsored by the U.S. Air Force.

"Pacific operations in World War II demonstrated that meteorological data about the tropical Pacific were inadequate and provided the impetus for obtaining a better weather picture of the region," he said. "The several atom bomb tests in the Pacific have furnished a large collection of tropical weather data. An analysis of these data by a U.C.L.A. group under the direction of Dr. C. E. Palmer and additional observations in the Pacific have revealed that conventional ideas on atmospheric circulation in the region are unrealistic."

The current estimate of tropical Pacific weather is as follows: In general, equatorial circulation is dominated by a broad easterly current, the vehicle of a long train of atmospheric waves moving westward and extending over the breadth of the Pacific. These atmospheric waves grow in amplitude until they finally break into vortices that stagnate seasonally over Australia or southeastern Asia to cause the monsoon season. A certain small proportion of these vortices intensify rapidly and become the typhoons that annually sweep through the Philippines and Japan.

How many scientists know about **UNESCO coupons** for books, films, and scientific instruments and material, purchasable in most countries except those behind the Iron Curtain, and usable for buying such articles in the other participating countries? The distributor for the U.S.A. is the UNESCO Office, UN Building, Room 2201, New York 17, N.Y. In most of the participating countries, the coupons can be sent direct to bookseller, publisher, or supplier.

In a lecture given at the Baltimore Section of the American Chemical Society, Bo Holmsted of the University of Uppsala dispelled much of the mystery surrounding the so-called "**nerve gases**" that were prepared by the Germans in the last war but never used. These substances are relatively simple organic phosphates with the general formula:



By inhibiting the enzyme cholinesterase, which is necessary to eliminate the acetylcholine formed by nerve endings, and so is necessary to permit renewed activity upon the release of acetylcholine, the nerve gases destroy nervous reactivity by, so to speak, permanently closing the switch. The action is like that of the organic phosphates used as insecticides. Low doses may be counteracted by prompt injections of atropine; but artificial respiration is required in most cases. Having captured several hundred tons of nerve gas from the Germans during the invasion, Russia, according to Holmsted, is very active in nerve gas research at the present time.

Scientists in the News

Roger Adams, professor of chemistry and head of the department at the University of Illinois, will receive the 1954 Perkin Medal in January from the American Section of the Societé de Chimie Industrielle in cooperation with the American Chemical Society, the American Institute of Chemical Engineers, and the Electrochemical Society. The medal is awarded annually for outstanding achievement in applied chemistry.

Rango Krishna Asundi, professor of physics and spectroscopy, Banaras University, India, is serving this year as a visiting professor in the Division of Physics, National Research Council of Canada.

The following scientists have recently joined the faculty of the Yale University School of Medicine: **Charles E. Carter,** formerly assistant professor of medicine at Western Reserve University, has been appointed associate professor of pharmacology; and **Stephen Fleck,** since 1949 assistant professor of psychiatry at the University of Washington, has been made associate professor of medicine.

Louis F. Fieser, Sheldon Emory professor of organic chemistry at Harvard University, recently received an honorary degree from the University of Paris. While in France, he gave a lecture before the French Chemical Society on the "Role of Cholesterol in Health and Disease." Prof. Fieser is known for his research in the chemistry of certain types of cancer. He synthesized vitamin K_1 and contributed a vital link in one of the methods of synthesizing cortisone. His recent work has led to new understanding of the nature and function of cholesterol.

Richard H. Follis, formerly associate professor of pathology at The Johns Hopkins University School of Medicine, has been appointed professor and head of the Department of Pathology at the University of Utah College of Medicine. Dr. Follis has carried on extensive research on the pathological aspects of nutrition and has made significant contributions to knowledge of diseases of the bone. In addition to his responsibilities at the Medical College, Dr. Follis will serve as pathologist to the Salt Lake General Hospital and consultant in pathology to the two Veterans Administration Hospitals located in Salt Lake City.

C. J. Mackenzie has resigned as president of Atomic Energy of Canada Limited. **W. J. Bennett,** president of Eldorado Mining and Refining Company Limited, has been elected as his successor. Dr. Mackenzie is continuing with the company in a consulting capacity. He has also joined Canadian Chemical and Cellulose Company Limited where he will serve on the board of directors as scientific advisor.

Carl V. Moore, professor of medicine at Washington University, St. Louis, has been named dean of the Washington University School of Medicine. Dr. Moore, who succeeds **Robert A. Moore,** will assume his new post March 15. The former dean will continue in his capacity of professor and chairman of the Department of Pathology until June, when he will go to the University of Pittsburgh to become vice-chancellor in charge of the five schools of the health professions there.

Edith Potter, well-known pathologist of the University of Chicago Lying-in Hospital, has recently been awarded an honorary degree, doctora honoris causa, by the University of Brazil at Rio de Janeiro as a tribute to her outstanding work in the field of pediatric pathology. The degree was presented at the dedication of the university's new hospital for children under two years of age.

The appointment of **Courtney Craig Smith,** president of Swarthmore College, as a director of the John and Mary R. Markle Foundation of New York has been announced.

Leo Szilard has been appointed professor of biophysics at Brandeis University. Dr. Szilard has contributed importantly to nuclear research. He and Enrico Fermi were in direct charge of the first project at Columbia University that led eventually to the development of the atomic bomb.

The 1953 Pan-American conservation award has been presented to **Francisco Tamayo,** Venezuelan biologist, for his reclamation of the Valley of Tacagua. The $2000 award is given annually by the Pan-American Union for outstanding achievements in conservation performed by Latin Americans. Dr. Tamayo was honored for his restoration of 30 miles of mountain ridges between La Guiara and Caracas that had been eroded to bare soil by ruthless forestry and bad agricultural practices, especially the uncontrolled grazing of sheep and goats. Dr. Tamayo convinced the Venezuelan government that the goats should be purchased, and that part of the human population be resettled elsewhere so that the remaining farmers could have a reasonable income. In the five years since Dr. Tamayo started his project, 30,000 grazing animals have been removed from the valley and scientific replanting has brought spectacular results. The experiment was so successful that the Venezuelan government has begun similar work in other parts of the country.

Arnold Tustin, distinguished British engineer and head of the Department of Electrical Engineering at the University of Birmingham, England, is occupying the Webster Chair of Electrical Engineering as a visiting professor at the Massachusetts Institute of Technology for the academic year 1953–54.

Charles B. Vail, who has been a research chemist for the Southern Research Institute, Birmingham, Ala., has been made professor of chemistry at Coker College, Hartsville, S.C.

Lincoln Washburn has been appointed professor of northern geology at Dartmouth College, effective in January.

Robert Burns Woodward has been appointed the first Morris Loeb professor of chemistry at Harvard University. The new professorship was established last spring to honor the memory of Morris Loeb, pioneer in physical chemistry and philanthropist who bequeathed funds for the support of physics and chemistry at Harvard. Prof. Woodward, a major contributor to research on quinine, cortisone, terramycin, and other natural products, accomplished the total synthesis of quinine, with the assistance of William von E. Doering, in 1944. In 1951 work by Prof. Woodward and Prof. Louis F. Fieser made possible a total synthesis of cortisone.

The 50th John Fritz Medal, highest honor of the engineering profession, has been awarded to **William Embry Wrather,** director of the U.S. Geological Survey. The award recognizes Dr. Wrather as "a geologist of worldwide experience and fame; an outstanding scientist and historian; a wise leader distinguished for his service to the Nation." This is a joint award by the American Society of Civil Engineers, American

Institute of Mining Engineers, American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

At the University of Arkansas, **V. H. Young,** who has served as head of the Department of Plant Pathology for the past 30 years, has become emeritus professor of plant pathology. He is succeeded by **E. M. Cralley,** a member of the Department for 22 years. Prof. Young will continue his research on cotton diseases on a part-time basis.

S. Husain Zaheer, director of the Central Laboratories for Scientific and Industrial Research, and professor and head of the Department of Chemical Technology, Osmania University, Hyderabad-Dn, India, has been named by the Institution of Chemists (India) as the 1953 H. K. Sen Memorial lecturer.

Education

The departments of agricultural chemistry and chemurgy in the **College of Agriculture, University of Nebraska,** have recently been combined into a single department of biochemistry and nutrition. The new department, headed by Robert Earl Feeney, formerly with the Western Regional Laboratory of the U.S. Department of Agriculture, will expand the programs of the old departments in basic biochemistry and animal nutrition.

The last four lectures of the **Harvey Society,** given under the patronage of the New York Academy of Medicine at its headquarters, are as follows:

Feb. 18, "Enzymes in Action in Living Cells." Britton Chance, professor of medical physics, The Eldridge Reeve Johnson Foundation for Medical Physics, University of Pennsylvania.

Mar. 18, "Oxidative Phosphorylation." Albert L. Lehninger, DeLamar professor of physiological chemistry and director of the Department of Physiological Chemistry, School of Medicine, The Johns Hopkins University.

Apr. 15, "Abnormality of Hemoglobin Molecules in Hereditary Hemolytic Anemias." Linus Pauling, professor of chemistry, chairman of the Division of Chemistry and Chemical Engineering, and director of the Gates and Crellin Laboratories of Chemistry, California Institute of Technology.

May 20, "The Control of Heat Loss and Heat Production in Physiological Temperature Regulation." James D. Hardy, professor of physiology, School of Medicine, University of Pennsylvania, and director of research, Aviation Medicine Acceleration Laboratory, Naval Air Development Center, Johnsville, Pa.

One of the most imposing buildings on Negro campuses in this country is the new million-dollar science building at **West Virginia State College** which was opened for use last spring. The structure houses the chemistry, physics, and biology departments. Chemistry has four basic laboratories and one research laboratory. There is a general chemistry laboratory capable of accommodating 56 students per section, an organic chemistry laboratory with a capacity of 30 students per section, and a physical chemistry laboratory of capacity of 8 students per section. Space and equipment are sufficient for as many as four sections in a laboratory.

The new physics laboratories have made it possible to increase greatly the offerings in electronics, experimental optics, photography, spectroscopy, and modern physics. The entire third floor of the building is occupied by the department of biology. To achieve maximum space efficiency, all laboratories are designed so that they can be used for laboratory, lecture, demonstration, and recitation purposes.

In the Laboratories

In November the corporate name of the Ethicon Suture Laboratories Incorporated, New Brunswick, N.J., was changed to **Ethicon, Inc.**

At Argo, Ill., **Shell Chemical Corporation** has just started to operate an alcohol-denaturing plant that is equipped to furnish the most generally used grades of specially denatured alcohols and proprietary solvents. The company's denaturing plant at Sewaren, N.J., will also be expanded.

Meetings and Elections

Officers for the **Association of Geology Teachers** for 1954 are: pres., Leland Horberg; v. pres., John B. Lucke; sec., Milton T. Heald; treas., Gerald M. Friedman.

A **Symposium on Monte Carlo Methods** sponsored by the Aeronautical Research Laboratory, Wright Air Development Center, will be conducted by the Statistical Laboratory, University of Florida, at Gainesville on March 16–17. An invitation to attend is issued to all persons interested in the field.

Following the Symposium, an Eastern Regional meeting of the **Institute of Mathematical Statistics** is being planned for March 18, together with meetings of the **Biometric Society,** Eastern North American Region, on March 18–20, also at the University of Florida. Further information may be obtained from Professor H. A. Meyer, University of Florida, Gainesville.

The regular meeting of the **Division of Fluid Dynamics** will be held during the Annual Meeting of the American Physical Society in New York, Jan. 28–30. The tentative schedule of sessions includes a session on shock waves in liquids and solids, two sessions of contributed papers, and a joint session with the Institute of the Aeronautical Sciences. The annual business session of the Division will be held on Jan. 30. The final program for the meeting will appear in a forthcoming bulletin of the American Physical Society.

Nearing the completion of its tenth year, the **Division of High-Polymer Physics of the American Physical Society** will hold its twelfth meeting at Detroit and Ann Arbor, Mich., March 18–20, marking the anniversary. A symposium on the Properties of Amorphous Polymers in Bulk is scheduled, along with other invited and contributed papers. The program has been arranged by a committee headed by T. G. Fox. For further information, write to W. James Lyons, Firestone Research Laboratories, Akron 17, Ohio.

Sigma Delta Epsilon officers for 1954 are: pres., Gladys J. Everson, University of Southern California, Davis; 1st v. pres., Emily T. Wolff, Wellesley College; 2nd v. pres., Elva Shipley Meyer, University of Wisconsin; sec., Mary Goidics, Barat College, Lake Forest, Ill.; treas., Teresa Cohen, Pennsylvania State College.

Miscellaneous

A new examination for **oceanographer** has been announced by the U.S. Civil Service Commission for filling positions paying from $3410 to $10,800 a year in the Hydrographic Office, Department of the Navy, and in the Coast and Geodetic Survey, Department of Commerce, in Washington, D.C., and throughout the country. The duties of these positions may involve extended periods at sea.

No written test is required. To qualify, applicants must show appropriate education or experience. Additional experience is required for the higher-paying positions. Applications must be filed with the Board of U.S. Civil Service Examiners for Scientific and Technical Personnel of the Potomac River Naval Command, Building 37, Naval Research Laboratory, Washington 25, D.C. Further information and application forms may be obtained from most post offices or from the U.S. Civil Service Commission, Washington 25, D.C.

Academic Press, Publishers, has announced the completion of plans for a new bimonthly journal, ***Radiation Research***, the official organ of the Radiation Research Society. Titus C. Evans, College of Medicine, State University of Iowa, is the Managing Editor.

Associate editors are: A. O. Allen, Brookhaven National Laboratory; A. J. Cipriani, Atomic Energy of Canada Limited; K. P. DuBois, University of Chicago; N. Giles, Yale University; L. H. Gray, London; L. H. Hempelmann, University of Rochester; H. S. Kaplan, Stanford University; S. C. Lind, Carbide and Carbon Chemicals Company; E. Lorenz, National Institutes of Health; H. M. Patt, Argonne National Laboratory; E. C. Pollard, Yale University; R. M. Sievert, Radiofysika Institutionen, Stockholm; C. Stern, University of California; C. A. Tobias, University of California; R. E. Zirkle, University of Chicago. The Executive Committee of the Board of Editors consists of H. J. Curtis and A. Edelmann, both of Brookhaven National Laboratory, and G. Failla of Columbia University.

Radiation Research will publish original articles dealing with all phases of radiation research to promote the integration of the disciplines of physics, chemistry, biology, and medical research as they are concerned with the effects of radiation on matter. The term "radiation" is here used in its broadest sense and specifically includes ionizing, ultraviolet, infra-red, and visible radiations. Vol. 1, No. 1 is scheduled to appear in February. Information about subscriptions may be obtained from the Academic Press, Inc., 125 E. 23 St., New York 10, N.Y.

A limited supply of **radioactive corticosterone** (Compound B) is now available to qualified investigators gratis through funds supplied by the Public Health Service's National Institute of Arthritis and Metabolic Diseases. Also available, obtained as intermediates in the synthesis of cortisone acetate, are: Pregnane-3,11,20-trione; 3α,17α-dihydroxypregnane,11,20-dione; and 17α,hydroxy-21-acetoxypregnane,3,11,20-trione. In addition, microcurie samples are available of: 3α,17α-dihydroxy-21-acetoxypregnane,11,20-dione; and 3α,-acetoxypregnane,11,20-dione.

These compounds are all labeled at position 4 with C^{14}, and have a specific activity of 0.49 mc/m.mole, except the corticosterone, which has a specific activity of 1.47 mc/m.mole. Cortisone acetate, identically labeled, having a specific activity of approximately ⅓ that of the previously announced cortisone acetate may also be obtained.

A concise letter describing the proposed research may be sent to the Endocrinology Study Section, Division of Research Grants, National Institutes of Health, Bethesda 14, Md. Transfer and use of these materials are subject to current Atomic Energy Commission regulations.

The preparation of these steroids was guided by a committee composed of T. F. Gallagher of the Sloan-Kettering Institute for Cancer Research, Gregory Pincus of The Worcester Foundation for Experimental Biology, and Max Tishler of Merck & Co., Inc. The Endocrinology Study Section of the National Institutes of Health, Charles B. Huggins, chairman, and Sam R. Hall, executive secretary, has administered the program. The United States Atomic Energy Commission gave the radiocarbon. Charles E. Frosst and Company synthesized the radiocortisone with help donated by The Upjohn Company. Tracerlab, Inc., supplied the methyl iodide. The Worcester Foundation, utilizing progesterone prepared by Frosst, biosynthesized the corticosterone. Essential technical knowledge and chemical intermediates were provided by members of the committee and others, notably Arthur Odell, formerly of Frosst; Carl Djerassi of Wayne University; H. G. Kolloff, R. H. Levin, and D. H. Peterson of Upjohn; Harold Levy of The Worcester Foundation; and George Rosenkrantz of Syntex, S. A., Mexico.

Technical Papers

Sublethal Total Body Irradiation and I^{131} Metabolism in the Rat Thyroid

Robert A. Monroe, John H. Rust, and Bernard F. Trum

The University of Tennessee-Atomic Energy Commission Agricultural Research Program, Oak Ridge, Tennessee

Histological examination of thyroids taken at autopsy from burros exposed to high levels of total body irradiation invariably has revealed a microfollicular gland with colloid depletion and tall acinar epithelium, indicative of extreme hyperthyroidism. In apparent agreement with these observations, Evans *et al.* (*1*) reported that 500–1000 r of total body x-irradiation caused an increase in the uptake of I^{131} by rat thyroids. However, Botkin *et al.* (*2*) found a progressive decrease in thyroid and serum protein-bound I^{131} to subnormal levels following a small initial increase in rats subjected to 1000 r of x-irradiation.

Consequently, it became of interest to study the I^{131} metabolism in the thyroids of rats exposed to total body irradiation, with particular reference to sublethal levels. Further, it was thought worth while to determine the relative amounts of I^{131} present in the protein-bound and thyroxine fractions as an index of the rate of thyroid hormone formation.

Groups of approximately 100 mature male Sprague-Dawley rats (150–200 g) were subjected to 333 and 665 r of gamma rays from Co^{60} on a special large animal exposure field (*3*) and to 500 r of x-rays from a General Electric Maximar[1] x-ray machine. The Co^{60} gamma rays were of 1.25 Mev mean energy shielded for the absorption of beta particles and a 40 cm minimum target distance. The x-rays were 250 kvp, with 1.0 mm of aluminum and 0.5 mm copper filtration and a target distance of 50 cm. The rate of administration for both x-rays and Co^{60} gamma rays was at approximately 34.5 r/min. The animals were kept in ventilated lucite boxes and exposed dorsally to the x-rays and bilaterally to the gamma rays. Feed (Rockland) and water were given ad libitum. All experimental groups were compared with nonirradiated controls.

I^{131} was injected intraperitoneally (100 μc/rat) at periods of 1, 7, and 30 days following irradiation. In order to follow the rate of formation of thyroid hormone, 6–10 irradiated rats and 4–6 controls were sacrificed at intervals of 1, 7, and 24 hr after administration of I^{131}.

Of each thyroid removed at the time of sacrifice, one lobe was placed in 10% formalin for histological study and the other lobe pooled with similar samples from the same group. The pooled thyroids were macerated and aliquot portions taken for the determination of total, protein-bound, and thyroxine I^{131}. Protein-bound and thyroxine fractions were obtained by the method of Taurog and Chaikoff (*4*). All measurements were made by direct solution counting with a shielded G-M tube. Blood samples were taken by cardiac puncture and treated in a similar manner.

A response was observed only in the thyroids removed from rats one day after exposure to 665 r of Co^{60} or 500 r of x-rays. At the 7- and 30-day periods the thyroid I^{131} levels of the irradiated rats were the same as those in the controls. At no sacrifice period did the serum I^{131} levels of the irradiated and control rats differ. No response could be detected in the rats exposed to 333 r of Co^{60}.

TABLE 1.

Hours after I^{131} injection	Total I^{131}	Protein-bound	Thyroxine	Total I^{131}	Protein-bound	Thyroxine
	665 r—Co^{60}			Control		
1	11.3	8.5	2.4	10.8	8.4	2.9
7	36.5	29.8	9.3	23.8	13.3	6.0
24	45.3	28.9	14.1	20.7	12.5	6.3
	500 r—X-ray			Control		
1	19.9	9.8	2.1	7.7	4.6	1.4
7	38.9	26.6	6.4	21.7	—	6.0
24	119.	56.8	22.0	30.4	18.2	7.0

In Table 1 comparative values are presented for the uptake and binding of I^{131} by the thyroids of rats 1 day after 665 r of gamma and 500 r of x-irradiation. These values are expressed as a percentage of the injected I^{131} per 100 mg of fresh thyroid tissue. The thyroids of rats receiving Co^{60} irradiation accumulated about twice as much as the controls, and the thyroids of the x-irradiated rats showed a fourfold increase over the controls. Moreover, the I^{131} in the protein-bound and thyroxine fractions increased concomitantly with the total I^{131} in both groups of irradiated rats, indicating that there was no impairment in the mechanism of thyroid hormone synthesis.

These results are consistent with the concept that the stimulus to the thyroid is indirect and not caused by the radiations per se. This concept is further sus-

[1] Through the courtesy of Herbert D. Kerman, Medical Division, Oak Ridge Institute of Nuclear Studies (present address: University of Louisville, Louisville, Kentucky).

tained by the fact that the burro thyroids mentioned above resemble those responding to large amounts of thyrotrophic hormone but showed no signs of radiation damage.

The report of Evans *et al.* (*1*) in which shielded thyroids of total body x-irradiated rats had an increased I^{131} uptake is of course much stronger evidence of the indirect effect of ionizing radiations upon that organ. It does not, however, eliminate the possibility of a direct effect upon the release of thyroid-stimulating hormone by the anterior pituitary.

The fact that thyroids of burros after lethal doses of radiation appeared to be receiving a much greater stimulus than the two- to fourfold increase measured in this study, plus the fact that none of the present rat thyroids showed histological evidence of stimulation, suggests that the extent of the thyroid response to total body irradiation is probably a function of the amount and/or rate of irradiation. The observation that there is a difference in the response of the thyroid to photons of different quality (i.e., that x-rays were more effective than Co^{60} gamma rays) agrees with lethal dose studies (*5*) and studies on skin (*6*) and lens of the eye (*7*) sensitivity.[2]

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[2] John J. Lane and Moyer Edwards assisted in the chemical procedures. Charles S. Simons, Oak Ridge Institute of Nuclear Studies, calculated the dose of Co^{60} gamma rays. This report is published with the approval of the director of the Experiment Station, University of Tennessee. The I^{131} was obtained from the Oak Ridge National Laboratory on allocation from the U.S. Atomic Energy Commission.

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The Salinity of the Ocean

Thor Rubin

McPherson Chemical Laboratory, Ohio State University, Columbus

Many authors (*1–3*) have noticed that the relative amounts of water, nitrogen, and volatile halides of volcanic origin approximate the composition of such volatiles in the atmosphere and hydrosphere. This fact has been used as a basis for arguments that the ocean was formed by the steady surface accretion of water from volcanic sources (*3*).

If the ocean were formed by volcanic action continued for a long time, it might be possible that nitrogen and halide too were collecting in the atmosphere and ocean respectively during the time the ocean was forming.

Table 1.

Amount in metric ton-atoms $\times 10^{-14}$	
Halide in ocean	7.6
Nitrogen in atmosphere	2.8

Though the terrestrial concentration of nitrogen is low compared to cosmic abundance of the element (*4–6*) it is quite plentiful compared to the inert gases.

Urey (*7–9*) suggested that nitrogen could be retained on the earth to the extent it is, as a metal nitride or as an ammonium halide. Both compounds could be held within the earth's crust under non-equilibrium conditions. Because the ammonium halides dissolved in water hydrolyze somewhat, they form acidic solutions that can rapidly penetrate basic rock. Many metal ions hydrolize too, but most of them also deposit insoluble silicates or carbonates which would lower the permeation rate of the solutions through the basic rock mantle.

By the time the water solution which originally might have contained ammonium chloride had reached the earth's surface, the solution would have become more basic and would consist of soluble alkali or alkaline earth halides and some ammonia besides gaseous hydrogen and nitrogen. The amount of nitrogen and hydrogen relative to ammonia would depend on the temperatures the solutions encountered.

As the remaining ammonia can be decomposed photochemically, provided that hydrogen can escape from the earth's gravitational field (*9*), atmospheric nitrogen plus some organic material results if reducing gases such as methane are present. The halide will be found in the sea. The amounts of nitrogen in the atmosphere and the halide in the sea should correspond on the basis of this picture. The degree of agreement is shown in Table 1. The weight of nitrogen in the atmosphere was taken from the work of Humphreys (*10*). The amount of halide in the ocean from Sverdrup, Johnson, and Fleming (*11*).

Since the amount of nitrogen is low relative to halide, nitrogen either may have escaped from the atmosphere with the hydrogen (*9*) or there is another accumulation of nitrogen on the earth.

The only accumulations that would appear to be large enough to contain 4.8×10^{14} metric ton-atoms of nitrogen would be the deep sea deposits. Based on sedimentation rates, Kuenen (*12*) estimated that deep-sea deposits laid down from Cambrian time should be of the order of 3 kilometers deep when compacted. Such deposits covering almost three-quarters (*13, 14*) of the area of the globe would weigh 1.8×10^{18} metric tons, assuming the compacted density of the deposits comparable to sandstone.

The most complete analyses of nitrogen in deep sea deposits are those described by Bradley (*15*) for the Globigerina ooze. The mean values for 11 cores was $0.022\% \pm 0.0012$ nitrogen of weight of the sediment (of about 75% porosity). No perceptible variation of nitrogen percentage with depth except that

caused by compaction was discernible in those cores. The chloride content of the sediments appears to be traceable only to the sea water occluded in them (*15*).

The nitrogen analysis data for Red Clay sediments are quite scanty for these most widely distributed ocean sediments. A Red Clay analysis for nitrogen reported by Andree (*16*) is 0.05% nitrogen for a dried core. The Blue Muds contain a considerable amount of organic material; however, no analyses for nitrogen seem to be available.

If one uses the value of 0.06% as the average composition of nitrogen for compacted sediments for all depths, the total quantity of nitrogen present on the ocean floor would amount to about 1.0×10^{14} metric ton-atoms accumulated from Cambrian times.

Perhaps such an assumption regarding the uniformity of nitrogen in sea sediments is not too bad for those sediments formed during the time that the atmosphere contained oxygen. It is almost certainly too low a value for sediments formed under a reducing atmosphere containing ammonia and methane, as postulated by Poole (*17*). The formation of insoluble organic compounds containing a considerable percentage of nitrogen could form in such gas mixtures (*18*) in the presence of light or by electrical discharges. Then the total nitrogen exclusive of possible sediments formed under reducing atmosphere would amount to about 3.8×10^{14} metric ton-atoms, which compares fairly well with the amount of halide in the ocean. It would appear that the available nitrogen on the earth's surface and the halide dissolved in the oceans could come from the same source of material (ammonium chloride). The accretion mechanism for the formation of the ocean also seems adequate to explain transport of both nitrogen and chloride to the earth's surface.

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The Effect of Exogenous Oxytocin in Blocking the Normal Relationship Between Endogenous Oxytocic Substance and the Milk Ejection Phenomenon

J. D. Donker,[1] J. H. Koshi, and W. E. Petersen

Dairy Department, University of Minnesota, Minneapolis

Normally, in the lactating cow, a combination of favorable stimuli to the teats of the mammary gland and to the auditory and visual sense organs brings about a release of an oxytocic substance from the posterior pituitary gland (*1*). This material is discharged into the blood stream and carried to the udder system where it causes the myoepithelium of the alveoli of the mammary gland to contract and discharge their milk (*2, 3*). Thus, the milk is ejected into the gland sinus from which it can readily be removed by the milking act.

Recently an experimental procedure was carried out in which the response to the usual let-down stimulus became essentially nonfunctional. A cow was milked hourly with the aid of 20 iu oxytocin administered intravenously at each milking for a period of 156 hr (*4*). Following the experimental period the cow was milked in the usual manner at 12-hr intervals. This is a report of the recovery period.

Common usage has dictated that the milk ejected following a normal milking under the influence of exogenous stimuli be termed "residual." It would be more precise to designate the milk left within the udder which was not removed under the influence of exogenous oxytocin or that which was left following a stimulus liberating supramaximal amounts of endogenous oxytocic principal as "residual" and to reserve the term "complementary milk" for the milk removed under the influence of an exogenous stimulation which is in excess of that normally obtained. This terminology would agree well with physiological terminology used for other organ systems. Henceforth, we shall reserve the term "complementary milk" for that milk obtained in excess of that normally expected and which is removed by means of an exogenous stimulation whether it be collected following a normal milking or included within a normal milking in cases in which the stimulus was applied prior to milking.

Previous to the hourly experimental milking this cow was producing approximately 40 lb of 4.0% milk daily. When the cow was again milked in a normal manner 12 hr following the hourly milking routine only about half of the expected milk was obtained. A butterfat determination disclosed that this milk was low in fat (1.3%). The udder remained distended and hard to the touch. Despite the fact that very little milk had been obtained (3.8 lb), she lost milk from all four teats in the interim between this first and the next

[1] Present address, Dairy Husbandry Department, University of Georgia.

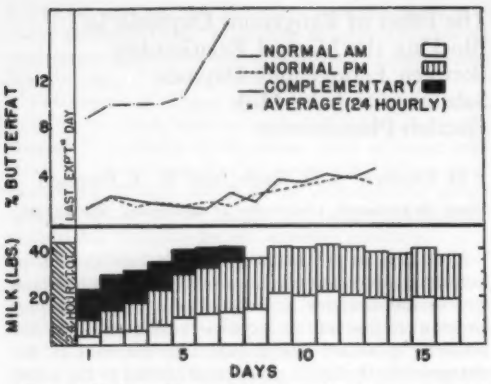

FIG. 1. Daily milk production in the recovery period following 156 hours of hourly milking. Twenty international units of oxytocin had been administered at each hourly milking. The total milk and average butterfat percentage of only the last 24 hr is indicated previous to the recovery period. Complementary milk was removed using decreasing amounts of oxytocin for a period of seven days in the recovery period at which time there was evidence of complete recovery of the ability to eject milk efficiently.

regular milking. At this second milking the condition was little improved. At this time she produced 6.5 lb of milk with a butterfat percentage of 1.6. The complementary milk was removed with the aid of an intravenous injection of 20 iu of oxytocin. There were 13.0 lb of this milk with a butterfat percentage of 8.9. The same procedure was followed in each of the next seven days. Oxytocin was given once daily in decreasing amounts according to the following schedule: 20, 20, 10, 6, 6, 3, 3 iu.

The complete recovery period data is presented in Fig. 1. The daily milk is partitioned into normally obtained A.M. and P.M. milks and P.M. complementary milk. The butterfat (%) of each of these fractions is also indicated.

In the days following the first day it is seen that the portion of milk which is complementary was decreasing in amount and increasing in butterfat content. The normally obtained amount of milk increased regularly throughout this week. At the seventh day, the complementary milk was considered normal (*5, 6*) and it was decided that she could go it alone. Subsequent production of milk and fat was essentially in the range of what might be expected. During a 10-day period following the third day after the last oxytocin injection she produced at a daily rate of 33.0 lb with a butterfat test of 3.9%.

This is believed to be the first reported instance in which treatment using exogenous oxytocin had brought about a refractoriness to the usual let-down stimuli in a normally responsive animal. It is logical to postulate that this blockage occurred at one of two sites. Either the posterior pituitary gland output of oxytocic substance was suppressed by the large amount of exogenous oxytocin that had been administered or the alveolar myoepithelial elements of the mammary gland had lost their sensitivity to physiological amounts of endogenously released oxytocic substance. The large amount of oxytocin administered over the previous 6½ days (3120 iu) appeared to disturb physiological relationships between the posterior pituitary gland and the contractile elements surrounding the alveoli of the mammary gland, but there is no evidence to favor which end of this axis had been blocked.

Although it is considered remote, there was the possibility that the hourly injection schedule may have prompted a conditioned reflex release of amounts of epinephrin sufficient to block the normal response to endogenously released oxytocic substance but not sufficient to block the effect of the administered hormone. One would then have to assume that the same conditions which had developed the conditioned release of epinephrin would not be maintained after changing the frequency of stimulation even after the reflex had become strongly established. It is possible that milk let-down blocking epinephrin may have been released as the result of a painful stimulus due to the high intramammary pressure occasioned by the change in milking frequency. The return to normal in the cow then being an adjustment to the reestablishment of this increased volume in the udder.

This paper records the observation that the milk ejection mechanism of a cow which was normally responsive was severely deranged. The most plausible explanation of this phenomenon is advanced.

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Paper Chromatography of Chlorophylls[1]

Alfred H. Sporer,[2] Simon Freed, and Kenneth M. Sancier

Chemistry Department, Brookhaven National Laboratory, Upton, Long Island, New York

In the hope of avoiding decomposition of chlorophylls reported to occur when they are subjected to paper chromatography, we impregnated the paper with sucrose and found that the degree of decomposition was brought virtually to zero. At the same time about the same degree and order of resolution into separate components was obtained as with the sucrose column and thus a mixture of chlorophylls

[1] Research carried out under the auspices of the U.S. Atomic Energy Commission.

[2] Present address: Chemistry Department, University of California, Los Angeles.

a and *b* was separated into two distinct spots and likewise a mixture of chlorophylls *b* and *b'*. In our experiments the developer consisted of ½% *n*-propyl alcohol in *n*-hexane, a solution which has proved effective in the analyses of chlorophylls with sucrose columns.[3]

Impregnation of the Paper.[4] (1) The impregnating solution consisted of 0.18 g/ml solution sucrose (Jack Frost sugar 6X) in distilled water, filtered through a Büchner funnel. Approximately this concentration seemed important for obtaining separations. (2) Strips of Whatman 1 chromatographic paper 3 cm wide were thoroughly wetted by soaking in this solution. (3) The wet papers were hung for drying in an oven at 100° C.

The Ascending Chromatogram. The next two steps were carried out in a semidarkened room. (1) The spot or spots to be analyzed were placed along a line across the paper about 3 cm from the bottom and were dried under a stream of nitrogen gas. (2) The strip was hung in a 250-ml graduated cylinder into which 10 ml developer had been added. Nitrogen gas was swept through to displace the air from the cylinder which was then stoppered. (3) The cylinder was placed in a refrigerator where the spots could develop at about 5° C in the dark.

[3] We are indebted to Miss LaVelma Thompson, now of the Rohm and Haas Co., and Kenneth Owens, Chemistry Department, University of Minnesota, for recommending this developer to us.

[4] Kirchner, J. G., and Keller, G. J. *J. Am. Chem. Soc.* **72**, 1867 (1950), included sugar among the substances with which paper may be impregnated for chromatography.

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The Use of a Fraction of Mechanically Disrupted Cells for Production of Group A Streptococcus Typing Antisera

Elizabeth Conroy and Elaine L. Updyke

The Communicable Disease Center, Public Health Service, U.S. Department of Health, Education, and Welfare, Atlanta, Georgia

The production of diagnostic antisera for the typing of Group A streptococci depends on the development of antibodies against the type-specific M proteins. Since these proteins are poorly antigenic in the purified state (*1*), the standard procedure for the production of streptococcus typing antisera (*2*) involves rabbit immunization with whole cell vaccines. Serum so produced must be absorbed to remove group-specific and other non-type-specific antibodies, a procedure which frequently results in sufficient loss of type-specific titer to render the serum useless. The work described here was undertaken in an attempt to reduce or eliminate the need for absorption through the use of vaccines containing the M proteins with only enough additional cellular material to render them adequately antigenic.

The approach was suggested by the report of Harris (*3*) on sonic disintegration of streptococci. In the present study streptococci were disrupted by mechanical means (*4*) and vaccines prepared from the fraction stated by Harris to contain most of the M protein. A method was developed which has proved to be of considerable value.

The packed cells from 500 ml of an 18-hr Todd-Hewitt broth culture of streptococci are suspended in 10–15 ml of physiological saline solution and transferred to a vaccine bottle (50–60 ml capacity) which is one-third full of sterile glow beads.[1] The bottle is closed with a sterile rubber stopper secured with adhesive tape, rolled in cotton, packed tightly in a paint can, and clamped in a paint shaker. After 1½ hr of shaking a gram-stained preparation of the suspension is examined. If more than occasional intact streptococcus cells are seen, the material is shaken another ½–1 hr. Most strains of streptococci are disintegrated in 1½ hr; a few require 2–3 hr.

When satisfactory disintegration has been effected, the fluid is poured off, the glow beads are washed with 40–50 ml of physiological saline, and the washings added to the first material removed from the bottle. The opalescent fluid so obtained is spun in a Servall centrifuge for 30 min at 5000 rpm. The supernatant fluid is discarded and the sediment is taken up in physiological saline equal in amount to one-fourth the volume of the original broth culture. The vaccine is heated for 30 min at 60° C to kill any cells which may have survived the shaking process. When the sterility check is completed, the vaccine is ready for use. The same immunization schedule is followed as that recommended by Lancefield for standard vaccines.

Vaccines made with this technique have been used successfully to produce antisera for 16 types of Group A streptococci. They failed to give good antisera for 3 types (34, 35, 44), 2 of which also failed with standard vaccines. Although simultaneous parallel studies with glow bead and standard vaccines have not been done, it is felt that results have been sufficiently clear-cut to warrant a report, with comments on the following facts and observations:

Antisera have been produced with these vaccines against 11 types (5, 6, 11, 13, 17, 19, 22, 36, 38, 40, and 42) for which it is relatively easy to prepare sera with standard vaccines, and also against 5 types (2, 8, 25, 27, and 32) for which it is notoriously difficult to prepare sera.

Antisera obtained from animals immunized with glow bead vaccines have little or no antibody for the group-specific carbohydrate (C substance). An absorption ratio of 20 parts of serum to one part of packed streptococcus cells usually is sufficient to remove group-specific and nonspecific cross-reacting antibodies. This is in contrast to the ratio of 3–6 volumes of serum per volume of packed cells required for absorption of sera produced with standard vaccines. It is probable that these absorption ratios are

[1] Cataphote No. 12 Glass Beads, Cataphote Co., Toledo, Ohio.

largely a reflection of the amount of C substance in the vaccines. Standard vaccines subjected to the acid-heat extraction procedure yield extracts which give strong reactions with both type-specific and group-specific antisera. On the other hand, glow bead vaccines similarly treated yield extracts which give strong type-specific reactions but weak or negative group reactions. Furthermore, if samples of the supernatant fluids (discarded in the preparation of the vaccines) are tested with standard Group A antiserum, they give strongly positive reactions, indicating that these supernates contain large amounts of C substance.

It appears that the disruption of the streptococcus cells and subsequent differential centrifugation serve to separate most of the group-specific C carbohydrate from the type-specific M protein. At the same time sufficient cellular material is retained in the sediment to render the M protein antigenic.

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Sulfhydryl and Disulfide in Keratinization[1]

E. J. Van Scott[2] and Peter Flesch

Department of Dermatology, University of Pennsylvania School of Medicine, Philadelphia

The common concept of sulfur metabolism in epidermal keratinization has been that the sulfhydryl groups of the Malpighian layer are converted to the disulfide bridges of the keratin molecule (*1–4*). This concept, based largely on histochemical evidence, is not fully supported by evidence derived from modern histochemical sulfhydryl reagents (*5, 6*). Direct chemical determinations of —SH and —S—S— in cutaneous structures are fragmentary, a circumstance which prompted the present study.

Sulfhydryl in ether-washed powdered tissues was measured with the specific Bennett reagent (*7*) after incubating the tissues in water for 1 hr at 40° C or in a 10% solution of Duponol (sodium lauryl sulfate) for 10 min in a boiling water bath. The increase of reactive —SH groups by the latter treatment is not due to splitting of —S—S— linkages inasmuch as: prolonged identical treatment of cystine or insulin yielded no —SH groups; keratin pretreated with iodoacetate, washed repeatedly with water, and then incubated with Duponol, yielded no —SH groups; lithium bromide, a hydrogen bond breaker (*8*), had the same effect as Duponol of increasing the —SH values of keratin.

Disulfide was estimated after conversion to sulfhydryl by incubating the tissues in a boiling water bath with 2 *M* KCN in 0.1 *N* NaOH. With this procedure, the disulfide values of insulin (*9*) and of various horny structures (*10*) were in agreement with data of previous investigators.

Human epidermis was isolated from surgical and autopsy specimens by the stretch method (*11*). Frozen plantar skin was cut into successive horizontal sections 50–75 μ thick; a portion of each section was examined microscopically to determine its histologic nature.

[1] This study was supported by U.S.P.H.S. Grant C-3601.

[2] National Cancer Institute, National Institutes of Health, Department of Health, Education, and Welfare, Bethesda, Md.

TABLE 1. Sulfhydryl and disulfide content of various skin structures.*

Tissue	Aqueous —SH†	Duponol —SH‡	% Sulfur as —S—S—	% Sulfur as —SH + —S—S—
Man				
Hair	6	11	5.7	5.7
Nails	9	146	3.41	3.46
Plantar calluses	14	49	0.342	0.358
Cow				
Hoof (lateral)	67	230	5.4	5.5
Hoof (plantar)	11	34	2.20	2.21
Hoof (Malpighian layer)	—	57	0.360	0.378
Horn (deep layers)	—	229	4.09	4.16
Horn (surface layers)	41	112	1.67	1.71
Horse				
Burr (horny layer)	9	82	0.305	0.331
Burr (Malpighian layer)	224	590	0.098	0.287

* Sulfhydryl expressed as $mM \times 10^{-3}$/100 g dry weight tissue.
† Values obtained after incubating tissues in water for 1 hr at 40° C.
‡ Values obtained after incubating in 10% Duponol for 10 min in a boiling water bath.

TABLE 2. Sulfhydryl and disulfide content of human skin.*

Tissue	Aqueous —SH†	Duponol —SH‡	% Sulfur as —S—S—	% Sulfur as —SH + —S—S—
Total plantar epidermis	25	88	0.341	0.369
Layers of plantar skin:				
Keratin	13.5	51	0.334	0.345
Keratin	24.5	65	0.323	0.343
Keratin + Malpighian layer	26	115	0.353	0.390
Malpighian layer + small amt. keratin	49	153	0.361	0.410
Malpighian layer + small amt. corium	—	305	0.317	0.415
Corium	0	7	0.033	0.035

* Sulfhydryl expressed as $mM \times 10^{-3}$/100 g dry weight tissue.
† Values obtained after incubating tissues in water for 1 hr at 40° C.
‡ Values obtained after incubating in 10% Duponol for 10 min in a boiling water bath.

The —SH and —S—S— values are listed in Tables 1 and 2. From these data the following conclusions may be drawn: (1) Significant amounts of —SH were found in all horny structures studied. (2) The rigid chemical distinction between hard and soft keratins on the basis of their sulfur content appears somewhat abitrary. Keratins form a series which contains transitional types. An example of such a transitional type is that found in the horse burr, heretofore considered a prototype of soft keratins. The horse burr is phylogenetically a rudimentary hoof, its keratinization differs histologically from epidermal keratin formation and chemically it resembles hard keratins by virtue of its horny layer having a higher disulfide content than its Malpighian layer. (3) The disulfide content of the Malpighian layer of the sole is in the same range as in the horny layer. This finding supports the theory that epidermal keratinization[3] starts in the depth of the Malpighian layer (*12*).

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[3] Differences between normal and pathologic human keratinization, confirming and extending Zingsheim's data (*13*) will be reported elsewhere.

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Isolation of *Histoplasma capsulatum* from the Air

Martha J. Ibach, Howard W. Larsh, and Michael L. Furcolow

Epidemiology Branch, Communicable Disease Center, U.S. Public Health Service, University of Kansas Medical Center, Kansas City

An epidemic of histoplasmosis in a farm family in Kansas following cleaning of an unused chicken house offered an excellent opportunity to sample the air for the presence of this organism. *Histoplasma capsulatum* had been isolated from the debris in the chicken house and from soil just outside. The infection had also been demonstrated in animals.

Another opportunity was provided in western Missouri when a soldier suffered an attack of severe pulmonary histoplasmosis after cleaning a chicken house.

Table 1.

Location	Date	Length of sampling time (hr)	Height of sampler opening from floor (ft)	Result
Atchison, Kansas	12–11–52	1.5	5	Neg.
	1–27–53	1.5	5	Neg.
	2–18–53	1.5	5	Neg.
	3–13–53	1.5	5	Neg.
	4–14–53	6.0*	2	Pos.
Beverly, Missouri	10–31–52	1.5	2	Neg.
	7– 8–53	9.0*	2	Neg.
	7– 8–53	4.5	5	Neg.
	7–17–53	8.0*	2	Pos.
	7–17–53	4.0	5	Pos.
	7–23–53	12.0†	2	Neg.
	7–29–53	13.5†	2	Pos.
	8– 6–53	9.0*	2	Pos.

* Combination of 2 simultaneous samples.
† Combination of 3 simultaneous samples.

H. capsulatum had been demonstrated in the debris in this chicken house also.

The atmosphere in these chicken houses was repeatedly sampled with portable Venturi scrubber air samplers (*1, 2*). The samplers were operated at 16 cfm. The plane of the Venturi opening was perpendicular to the ground. The debris on the floor of the chicken houses was not disturbed during the sampling period. The organisms in the distilled water in which the air was washed were collected by using the Goetz Millipore filter and injected into Swiss white mice. Sterile equipment and technique were employed throughout. Five of thirteen samples were shown to contain *H. capsulatum*. Details of the sampling are summarized in Table 1.

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Auxin-florigen Balance in Flowering of Soybean[1]

J. E. Fisher and W. E. Loomis

Department of Botany and Plant Pathology, Iowa State College, Ames

Since Dostál and Hosek (*1*) first showed that flowering of plants could be delayed or prevented by growth hormone, or auxin, there has been an increasing feeling that auxin may be antagonistic to the postulated flowering hormone, or florigen. Bonner and Thurlow (*2*), Galston (*3*), and Leopold and Thimann (*4*) have observed tendencies toward flowering in plants held on noninductive photoperiods and treated

[1] Journal paper No. J-2383 of the Iowa Agricultural Experiment Station, project 1139.

TABLE 1. Percentage flowering of soybean plants treated with auxin or anti-auxin.

Treatment	Lincoln		Ogden	
	18-hr day, 75 days old	16-hr day, 85 days old	14.5-hr day, 100 days old	16-hr day, 120 days old
Control	0	11	0	0
Nicotine sulfate	56	100	67	33
Auxin	0	0	0	0
TIBA	58	—	—	—

with "anti-auxins," or significant increases in flower number from such treatments in plants receiving minimum photo-induction.

The behavior of the midseason soybean variety Lincoln, under certain conditions, has led us to conduct an extensive study of hormone balance and flowering in this and the later variety Ogden. Spraying 1- to 2-month-old Lincoln or Ogden plants with a nicotine sulfate spray at a concentration of about 2000 ppm has caused the production of abundant and apparently normal macroscopic flowers under noninductive treatments (Table 1). The appearance of these plants suggested that the nicotine was acting as an "anti-auxin." The "anti-auxin" 2,3,5-triiodobenzoic acid (*3*) was accordingly used in the same way, at 10 ppm. Inhibition of new growth and formation of macroscopic flowers on noninducted plants were again observed in clear-cut experiments. "Anti-auxin" treatments induced earlier flowering or flowering when the controls remained vegetative, flowering at lower nodes, and more flowers per node (Table 2).

Under conditions of good light and moderate fertility, Lincoln soybeans were observed to flower on 18-hr photoperiods when 3–4 months old. Borthwick and Parker (*5*) have noted a tendency for older larger soybean plants to flower on days too long for flowering of younger or more vigorous plants. If we assume that a flowering hormone produced in older leaves (*6, 7*) is antagonized by growth hormone produced in apical meristems and young leaves (*8*), we would expect this late-flowering response in plants that continue to produce mature leaves from an essentially unchanging apical region. The ratio of florigen-producing tissue to auxin-producing tissue would eventually become great enough to cause flowering in plants in which rapid destruction of florigen was not induced by long photoperiods. Comparisons of the area of mature and of expanding leaves at the time of the appearance of macroscopic flowers showed a ratio of 5 to 1 in Lincoln soybeans on 11.5-hr photoperiods, increasing to 15 to 1 on 18-hr photoperiods. Ratios were reduced toward the short-day level by the "anti-auxin" treatments (Table 2). Control plants of Ogden flowered at the 7th node on a 14.5-hr photoperiod with a leaf-area ratio of 19 to 1, and did not produce macroscopic flowers on longer photoperiods; but nicotine-treated plants flowered on a 16-hr photoperiod with a ratio of 16 to 1.

TABLE 2. Lincoln soybeans, 120 days.

Treatment	Photoperiod			
	16 hr	14.5 hr	13 hr	11.5 hr
Lowest flowering node				
Control	6.9	5.2	4.0	3.6
Nicotine sulfate	3.9	3.6	3.1	3.0
Avg. no. flowers per node				
Control	2.3	2.5	2.9	3.0
Nicotine sulfate	4.0	4.1	4.6	5.0
Ratio of mature to immature leaf area at flowering				
Control	14.7	11.5	8.2	5.0
Nicotine sulfate	8.5	6.5	5.7	4.2

As a further test of the ratio hypothesis, apical buds or immature leaves were removed from Lincoln plants of varying age and size. Removal of the bud forced axillary growth and delayed or prevented flowering. Continued removal of immature leaves as they formed forced young plants into early flowering on 18-hr photoperiods (Table 3). Spraying immature leaves with "anti-auxin" was more effective in inducing flowering than spraying entire plants, and was much more effective than spraying only mature leaves.

TABLE 3. Defoliation and flowering of Lincoln soybean on 18-hr photoperiods.

Treatment	Percentage flowering, days			Lowest flowering node
	77	84	91	
Control	0	0	33	5.6
One mature leaf removed	0	0	17	5.5
Immature leaves removed*	33	100	100	2.0

* All embryonic leaves removed after 4th trifoliate leaf matured.

Spraying with auxin delayed flowering of these plants only when total growth was greatly reduced, and the delay is considered to have been a general rather than a specific effect. Lighter auxin treatments of plants previously treated with nicotine sulfate hastened and increased flowering. This result would be expected if auxin may be inhibiting for floral induction but is necessary for growth of flowers.

Much evidence has accumulated that plants must attain a certain size before they are affected by induction treatments. Purvis and Gregory (*9*) called this stage the ripe-to-flower condition. Although many interacting factors are possible, the size factor in cabbage (*10*) and celery (*11*) appears to be the area of mature, and presumably florigen-producing, leaves.

Our data provide clear-cut support for a theory of hormone control in flowering. They do not differentiate between a balance of auxin and florigen or a balanced level of auxin alone, controlled by hormone production and the production of a natural "anti-auxin" such as Roberts (*12*) has isolated from flowering plants. The varying responses of *Xanthium* and soybean, for example, may indicate that the flowering hormone is

actually some "anti-auxin," and that the growth hormone is an antiflowering hormone when present in more than optimum concentration. At still lower concentrations, auxin may limit flowering because it is present in insufficient concentration to support the essentially vegetative growth of flower parts (*4*).

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Comments and Communications

On Geochemical Effects of Freezing

It has been shown that growing ice as it forms from dilute (10^{-2} to 10^{-6} *M*) solutions of many ionic compounds selectively incorporates ions of one sign into the nascent surface layers (*1, 2*). The effect is sensitive to the nature and abundance of ions in the solution, but it is readily exhibited by a number of different inorganic salts which have been tried in laboratory samples. As the ice surface develops beyond the point of attachment of the impurity ion, the space charge in the ice and in the solution is neutralized by the circuitous passage of a counter electric current, leaving the impurity centers distributed uniformly throughout the bulk ice. In many freezing situations the process produces an effective chemical action due to the primary ion separation, and to the associated electrochemical action of the current in the unfrozen electrolyte.

A consideration of the geochemical significance of these phenomena as they occur in nature should not be overlooked. The alkali halides in solution are such as to give conditions of high selectivity in the process, and CsF will serve to illustrate the action and indicate the quantities involved.

A solution of CsF (10^{-5} *M*) will result in the placement of approximately 10^{16} fluoride ions per cubic centimeter of ice, rejecting almost completely the cesium ions. Calculations yield the following quantities.

Population of fluoride ions relative to water molecules in the ice	$1:3\times10^{6}$
H_2 liberated/m³ of ice frozen	1/120 gmol
O_2 liberated/m³ of ice frozen	1/240 gmol
Number of repeated freezings required to dissociate ½ of the water involved	10^{6}
Depth of world ice formation to liberate H_2 equal to that present in the atmosphere (optimum conditions)	3 m

These effects may influence also the presence of heavy ions in terrestrial waters where freezing occurs. Consider, for example, a solution of cupric halides. Many conditions of freezing in nature will provide a suitable electrode configuration to effect an electrolytic deposition of copper from the solutions. Such depositions of copper may be responsible for some native copper occurrences.

In attempting to estimate the geochemical consequences of natural freezing, it is important to point out that knowledge of the processes here suggested has been developed for the most part from laboratory tests on controlled impurities. The measurements which are made on growing ice in the laboratory are sensitive to types of impurities and to certain contaminants such as excess CO_2 which prevent or obscure the action illustrated. Sea water has been used in laboratory tests, however, and the basic electrical manifestations have been verified for this substance. One can say with reasonable certainty that the freezing of water is a significant agency for influencing the concentration and nature of the solute materials of terrestrial water.

E. J. Workman[1]

New Mexico Institute of Mining and Technology
Socorro, New Mexico

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Optical Masking Device for the Aminco-Stern Electrophoresis Apparatus

The photographic recording of electrophoretic patterns is often impeded merely because of the optical properties of the material under examination. Thus, in blood serum, portions of the curve may be almost invisible due to coloration caused by partial hemolysis, or the albumin peak may be so sharp that it is impossible to obtain a photograph which includes the tip of the peak without overexposing the remainder of the curve. A system which allows for masking of

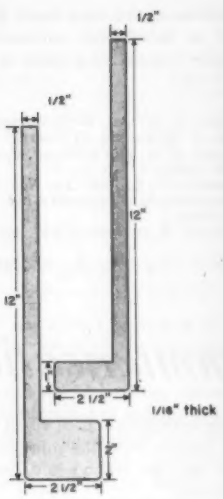

FIG. 1. Masks.

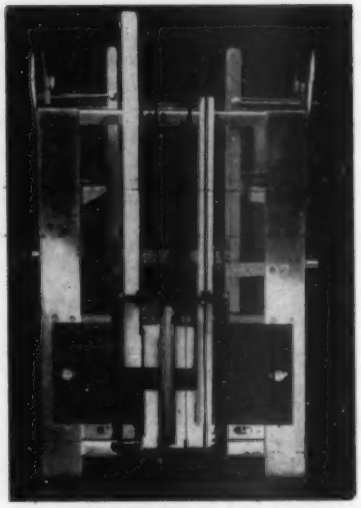

FIG. 2. Masks in cell holder.

areas of high light transmission in order to effect a balance in overall photographic exposure would be a solution to this problem. Such a device has been developed for use with the Amineo-Stern electrophoretic apparatus (Universal Model)[1] and is described below.

Masking sheets are cut from thin (1/16 inch) opaque plastic (Plexiglas or similar type) to the dimensions shown in Fig. 1. These "golf-club" shapes are placed in between the shutter bracket and plate of the cell holder, and each adjusted to the desired level by means of the top of the strip. Proper tension on the masks is maintained by pressure from one of the vertical shutters of the cell holder. Masks may be used singly or in a pair (as shown in Fig. 2) to provide the desired effect of either single or double masking, respectively. Thus for colored solutions one mask is used to cover the non-colored portion of the cell, while two are used to increase the exposure time on an albumin peak by masking out the areas on both sides of that peak. A typical example of the former situation is illustrated in Fig. 3.

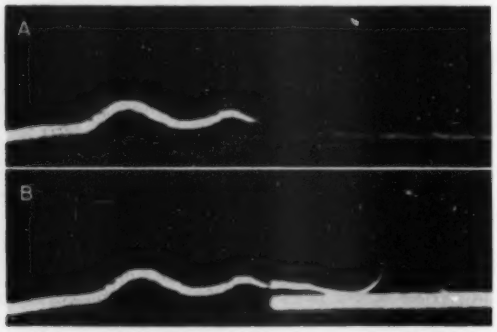

FIG. 3. Highly colored serum. A, film exposed for 7 sec without masking. B, same serum, but film exposed for 7 sec on the left and 60 sec on the right using a single mask.

[1] Made by the American Instrument Company, Inc., Silver Spring, Maryland.

Although this device is designed for the Amineo-Stern Universal Model Analytical Double-Cell Holder, masking strips of analogous dimensions and shapes may be used on other Amineo models.

A. I. SCHEPARTZ

Allergy Research Laboratory
Veterans Administration Hospital
Aspinwall, Pennsylvania

Received October 15, 1953.

Outbreak of Malaria with Prolonged Incubation Period in California, a Nonendemic Area[1]

THE recent appearance of 34 related cases of malaria in one area of California has afforded an unusual opportunity to observe the natural history of *P. vivax* malaria in a nonendemic area. The investigation of this outbreak, started in August 1952, is still in progress. The interest expressed by several malariologists in the rather unique circumstances surrounding this outbreak has prompted this preliminary report.

All elements of a well-organized scientific study were naturally combined to permit an epidemiologic evaluation of malaria in a nonimmune population living in a nonendemic locality. One relapsed case exposed to innumerable anopheline mosquitoes at a semi-isolated summer vacation area of over 1800 Camp Fire Girls localized the situation.

The epidemiologic investigation was greatly simpli-

[1] From California State Department of Public Health. Acknowledgment is made to Roy Fritz, Senior Scientist, U.S.P.H.S., who is co-author of final report in manuscript.

fied by the availability of existing records for previous years. The State Health Department had not recorded naturally contracted malaria in California since 1945. Thus the designation of the place of exposure was not hampered by the problem of endemicity. The persons exposed were, for the most part, vacationists whose usual residences were in many sections of central California. These persons were drawn almost exclusively from members or individuals associated with the Camp Fire Girls organization whose records contained invaluable information permitting definition and follow up of the population at risk.

An exhaustive investigation has revealed only one possible source for these 34 cases. This person, a Korean veteran, suffered a relapse of *P. vivax* malaria while camping near the summer encampments of the Camp Fire Girls on July 4, 5, 6, 7, 1952. The identification of this person clarified the chain of events and permitted this unique opportunity for observation.

Undoubtedly the most interesting aspect to date has been the establishment of the incubation period. The camps opened late in June and closed early in August. In all probability infective mosquitoes were active in the area after July 10th. All the cases had been in the area after this time and there has not been a case reported in the group who was there before July 10th. Nine of the cases occurred last fall with incubation periods ranging from 12 to 38 days. Twenty-five persons experienced their first attack this spring with incubation periods from 226 to 307 days. The first onset date was August 3, 1952, and the last July 6, 1953.

Thirty-one of the cases were females (ages 9 to 47) and three were males (ages 30, 33, 50). None of them had any previous exposure to malaria, all but two have been laboratory confirmed as *P. vivax* infections. None of the 1953 cases had any symptoms of malaria prior to their onset this spring.

This single source outbreak supports the hypothesis that two-thirds of the *P. vivax* infections contracted in autumn remain clinically latent for eight to nine months (*1*). Whether or not these 25 persons represent the total number of latent cases cannot be stated at this time.

The opportunity to follow the majority of the 1200 campers who were at the camps after July 10 has been facilitated by the number of these who returned to camp this year. The evidence accumulated so far indicates that there have not been any "missed cases" and that the occurrence of additional cases is highly speculative.

ROSEMARY BRUNETTI

Bureau of Acute Communicable Diseases
Berkeley, California

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Book Reviews

Methods of Mathematical Physics, Vol. I. Trans. from 2nd German ed. R. Courant and D. Hilbert. New York–London: Interscience, 1953. 561 pp. $9.50.

This English language version of the well-known "Courant-Hilbert" will be very much welcomed, especially by younger physicists in all fields; the older generation will, of course, already have on their shelves a very familiar and much-used copy of the former German edition. The original book, ***Methoden der Mathematischen Physik*** was written in a period when the interests of mathematicians and physicists were clearly diverging and it presented in a clear and systematic way the results of much mathematical research which was very relevant to the needs of physicists. It succeeded admirably in its purpose of making physicists aware of the essential unity of the mathematical methods which they were employing in widely differing fields. It also provided a much-needed source book for many mathematical developments which were to be found only in the mathematical journals and which might otherwise have been overlooked by physicists.

This new edition is for the most part a very clear and readable translation of the earlier German edition; a large number of minor corrections and modifications have been made without, however, any alteration in the essential pattern of the book. In this respect particularly, it has been most fortunate that one of the original authors has been able to supervise in detail the preparation of this edition. In this first volume, the chapter headings are: The Algebra of Linear Transformations and Quadratic Forms, Series Expansions of Arbitrary Functions, Linear Integral Equations, The Calculus of Variations, Vibration and Eigenvalue Problems, Application of the Calculus of Variations to Eigenvalue Problems, and Special Functions Defined by Eigenvalue Problems. To this last chapter has been added an 11-page appendix that discusses the transformation of spherical harmonics when the coordinate system is rotated about the origin deriving explicit expressions for the transformation coefficients. As a source book, it has been considerably brought up to date by a four-page bibliography referring to many important books and some papers containing more recent developments in the above fields. The index has also been revised and considerably expanded.

The influence of this book in the development of physical theory has been significant. For example, as will be seen from the chapter headings above, the mathematical methods described were just those which

were needed in the development of the theory of quantum mechanics, which was beginning to make great strides at about the time of the publication of the first edition. For the quantum theoretician in particular, it will always be an almost indispensable handbook, but also mathematical physicists in all other fields will find a useful account of many of the mathematical methods they need. It is to be hoped that Professor Courant's plan to rewrite and modernize the book, although postponed for the present, will be achieved in the not-too-distant future, especially as there are still so many fields of mathematics of great importance to physicists, such as the theory of singular integral equations and of iterative processes, for which no treatment of comparable viewpoint yet exists.

HANS A. BETHE

Laboratory of Nuclear Studies
Cornell University

Plant Diseases in Orchard, Nursery and Garden Crops. Ernst Gram and Anna Weber; trans. from 2nd Danish ed. by Evelyn Ramsden; R. W. G. Dennis, Ed. New York: Philosophical Library; London: Macdonald, 1953. 618 pp. Illus. + color plates. $18.50.

This book is a handsome production, beautifully printed on a glossy paper, and illustrated by a large number of excellent black-and-white photographs and drawings. Ten color plates are included; some of these are not distinguished by veracity of color. As the title indicates, it deals only with diseases of orchard, nursery, and garden crops—primarily those of northern Europe. The authors, who are leading Danish pathologists, prepared the first edition under the shadow of World War II, largely for use by Danish growers. A second edition was required by 1944, and it is this which, after translation, has been edited and revised by Dr. Dennis of the Royal Botanic Gardens, at Kew, to adapt it to the needs of an English audience. In his words, the editor "has also taken the opportunity . . . to include references to much English work, published since 1940, not available in Denmark until after the second Danish edition was published." Also added is an account of the legislative control measures practised in Great Britain. It is stated that this book was compiled primarily for the use of the growers themselves, which may well be so, but it does assume an awareness and understanding of mycological and pathological terminology that would not be possessed by most small growers in the U.S. The treatment is essentially practical, however, rather than academic, but it could hardly be described as popular.

The book is divided into five sections, each with a bibliography. The first section which deals with the nature of plant diseases and disorders, including nutritional deficiencies and chemical toxicities, includes few citations to American authors, but in the following three sections which deal, respectively, with Tree and Bush Fruit, Vegetables and Herbaceous Fruit, and Ornamental Plants and Trees, some relevant U.S. references are given. A useful feature of these sections is the inclusion of keys for the identification of diseases of some of the major plants. The final section treats, somewhat perfunctorily, disease control practices. Certain of these recommendations are at variance with those developed for the same crop in North America—particularly perhaps is this the case with the fruit crops. Some of the newer fungicides and protectants are not mentioned, perhaps because of unavailability in Denmark.

Within the limitations referred to above this book has much to commend it; perhaps the most appropriate comment to make would be that there might well be a place for a North American edition of "Gram and Weber." This, the English edition, will be of interest here primarily to students and libraries.

A. G. NORMAN

Department of Botany
University of Michigan

Mr Tompkins Learns the Facts of Life. George Gamow. New York: Cambridge Univ. Press, 1953. 88 pp. Illus. $2.75.

Professor Gamow's account of the adventures of Mr Tompkins in the field of biology does not merit a long review in a publication read primarily by scientists. The biological scientist has at hand better information than is contained in the book, and the physical scientist will want a more authoritative popularization than can be supplied by an author summarizing material remote from his field of specialization.

The general reader will be entertained, will not be irked by the numerous factual errors, and will gain a very considerable amount of important information. He will also, perhaps, become convinced that there is nothing wrong with biology that a few biologists can't fix. Theoretical physicists, Mr Tompkins is authoritatively informed, should be able to solve biological problems by the application of mathematical tools. It is to be hoped that this is true, because any device for bypassing a subject as uninteresting as chemistry would be welcomed by both biologists and physicists.

M. J. JOHNSON

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An Appeal of Cytologists

IN 1939, the International Union of Biological Sciences (see p. 58) requested Professor P. Martens, director of the Carnoy Institute in Louvain, Belgium, to resume the project of an International Depository of Cytological Slides, zoological and botanical. This proposition had previously been submitted to the late Professor V. Grégoire by the Union; but, owing to his poor health at the time, he was unable to bring it into operation. On the other hand, the state of war and the international situation have delayed up to this day the announcement of the creation of this organization.

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P. MARTENS

Administrator of the Depository
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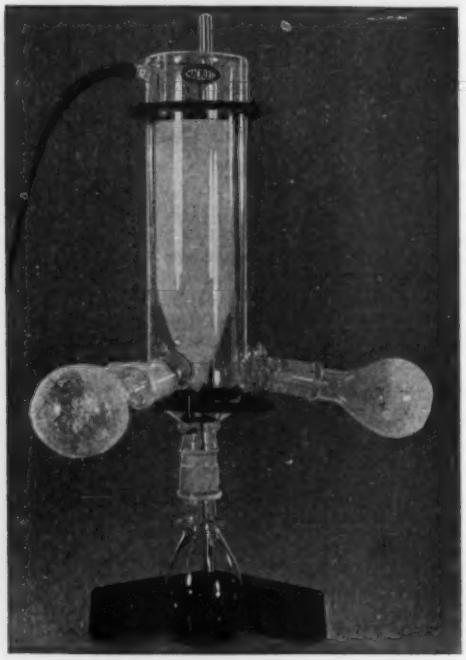

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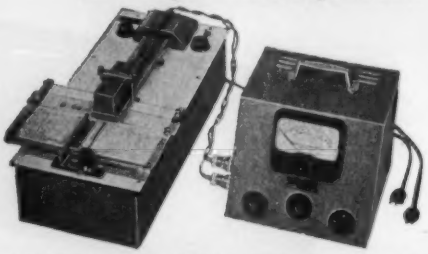

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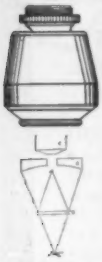

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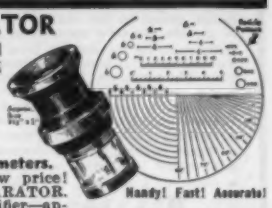

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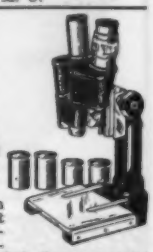

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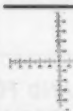

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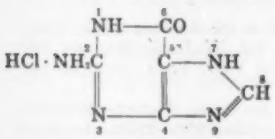
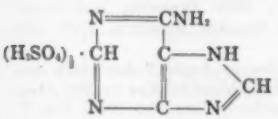


that stand picturesquely on old New England wharves or as a by-product from the isolation of adenine. It is of some commercial importance as an ingredient of pearly lacquers.

Adenine itself we might obtain from glandular tissue or from tea, but we choose to make it from the nucleic acid in brewer's yeast. We



sell it as *Adenine Sulfate* (Eastman 1645).

In nature the enzyme adenase deaminates adenine to 6-oxypurine and when this takes on water it becomes 2,6-dihydroxypurine, otherwise known as *Xanthine*, which is present in muscles, spleen, and urine and which we carry in highly purified crystalline form as Eastman 1644. One more oxygen in the 8 position of the purine structure gives *Uric Acid*, one of the principal constituents of kidney stones, available from us as purified crystals (Eastman 544).

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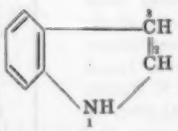
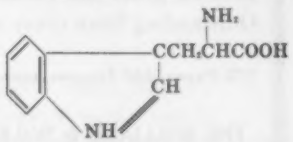


a chemist who happens to be olfactorily totally blind and deaf—a valuable man.) Despite its central role in scatology, *Skatole* is also a fixative in fine perfumery. Where in the misty seas between psychophysics and psychoanalysis lies the explanation of this dichotomy, we know not.

Both indole and skatole are breakdown products of the essential amino acid *L-(-)-Tryptophane*. This, too, we



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Annual Report, 1951. Central Laboratories for Scientific and Industrial Research. Hyderabad–Deccan, India: Osmania Univ. Press, 1953. 57 pp.

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Current Biological Research in the Alaskan Arctic. Univ. Ser., Biological Sciences, Vol. XI. Ira L. Wiggins, Ed. Stanford, Calif.: Stanford Univ. Press, 1953. 55 pp. Illus. $1.00.

Driver Characteristics and Accidents. Highway Research Board Bull. 73. 54 pp. Illus. 90¢. ***Traffic-Accident Studies.*** Bull. 74. 53 pp. Illus. 90¢. Washington 25, D. C.: National Academy of Sciences, National Research Council, 1953.

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Farwelliana. An account of the life and botanical work of Oliver Atkins Farwell, 1867–1944. Bull. No. 34. Rogers McVaugh, Stanley A. Cain, and Dale J. Hagenah. Bloomfield Hills, Mich.: Cranbrook Inst. of Science, 1953. 101 pp. Illus. 75¢.

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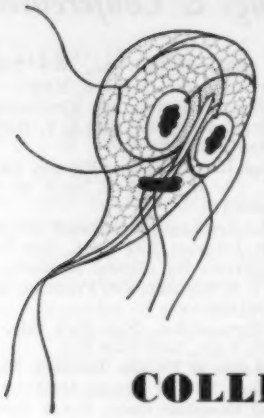

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25–27. American Soc. of Heating and Ventilating Engigineers, 60th annual, Houston, Tex. (A. V. Hutchinson, 62 Worth St., New York 13.)

25–27. Conf. on High Energy Nuclear Physics, 4th annual, Rochester, N.Y. (R. E. Marshak, Dept. of Physics, Univ. of Rochester.)

25–29. Inst. of the Aeronautical Sciences, annual, New York City. (S. P. Johnston, 2 E. 64 St., New York 21.)

28. American Federation for Clinical Research, annual, Portland, Ore. (I. S. Edelman, San Francisco Hospital, San Francisco 10, Calif.)

28–30. American Physical Soc., New York City. (K. K. Darrow, Columbia Univ., New York 21.)

28–30. American Assoc. of Physics Teachers, New York City. (R. F. Paton, Univ. of Illinois, Urbana.)

28–30. High Speed Computer Conf., Baton Rouge, La. (L. Megginson, Louisiana State Univ., Baton Rouge.)

29–30. American Geophysical Union, Los Angeles, Calif. (J. P. Marble, 3221 Macomb St., NW, Washington, 8, D.C.)

29–30. Conf. on Protein Metabolism, 10th, New Brunswick, N.J. (W. H. Cole, Rutgers Univ., New Brunswick.)

29–30. Western Soc. for Clinical Research, 7th annual, Portland, Ore. (H. N. Hultgren, Stanford Hospital, San Francisco 15, Calif.)

February

1–5. American Soc. for Testing Materials, Spring, Washington, D.C. (R. J. Painter, 1916 Race St., Philadelphia 3, Pa.)

4. Instrument Soc. of America, Regional Conference, 9th annual, New York City. (L. Butzman, 103 Park Ave., New York, N.Y.

4–6. American Soc. for Quality Control, Textile Quality Control Conf., 4th annual, Raleigh, N.C. (D. Shainin, 70 E. 45 St., New York, N.Y.)

4–6. Inst. of Radio Engineers Conf. and Electronic Show, Tulsa, Okla. (D. R. Davis, P.O. Box 7221, Tulsa.)

5–6. Chicago Ophthalmology Soc., annual clinical, Chicago, Ill. (F. W. Newell, 950 E. 59 St., Chicago 37.)

7. Assoc. for Research in Ophthalmology, Midwest Section annual, Chicago, Ill. (F. W. Newell, 950 E. 59 St., Chicago 37.)

8–9. Conf. on Marine Corrosion Problems, Berkeley, Calif. (Dept. of Conferences and Special Activities, Univ. of California, Berkeley.)

13–14. American Educational Research Assoc., Atlantic City, N.J. (F. W. Hubbard, 1201 16 St., NW, Washington, D.C.)

14–16. National Soc. of College Teachers of Education, Atlantic City, N.J. (C. E. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

12–25. Latin American Cong. of Oto-Rhino-Laryngology, 3rd, Caracas, Venezuela. (V. Marquez Reverson, Centro Medico, Caracas.)

15–18. American Inst. of Mining and Metallurgical Engineers, New York City. (E. H. Robie, 120 E. 41 St., New York 17.)

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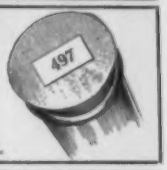

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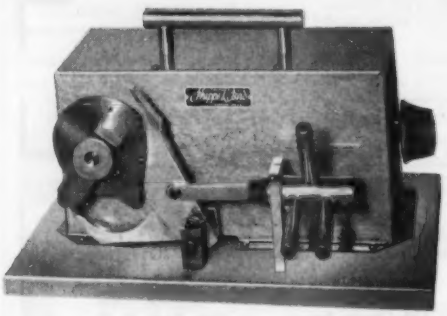

This valve in conjunction with a source of compressed air is used to control artificial respiration. Control of one knob facilitates respiration rates of 15 to 50 per minute. The inspiration to expiration time ratio may be set to any value between 1:4 to 4:1. By loosening one screw the valve may be removed for cleaning and sterilizing.

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